TYPE SR-212

VHF/UHF SURVEILLANCE RECEIVER

AND

SPECTRUM DISPLAY UNIT

INSTRUCTION MANUAL

Astro Communication Laboratory
9125 Gaither Road
Gaithersburg, Maryland

Receiver SR-212 Addendum

1. Page 2-5: Add the following specifications:

Receiver Desensitization	A desired RF signal of 1 uv modulated 50% at 1000 cps, measured at audio amplifier output, is attenuated no more than 3 db on Band A and B (30-260 mc) and no more than 6 db on Band C and D (250-1000 mc), with AGC in operation, when an undesired signal 60 db above the 1 uv desired signal is brought within ±1 mc of the desired signal.
Intermodulation Products	When two IM product causing signals, one CW, and one AM signal modulated 30% at 1 kc, are fed to the receiver and increased simultaneously until the receiver output equals that produced by a desired AM signal of 3 uv modulated 30% at 1 kc and of the same frequency. The IM product signals are at least 70 db (10 mv) for Band A, B, and C and at least 80 db (30 mv) above the desired signal on Band D.

Main Chassis:

1. Page 6-6:

a. Change R1, R2, R4, and R13 to "10 K ohms, Variable, Clarostat, 57M-10K".

b. Change R7 to "100 ohms, Variable, Clarostat, 57M-100".

c. Change R11 to "Resistor, Fixed Composition, 1.8 K ohms, ±5%, 1W".

d. Change R12 to "Same as R11".

e. Change R14 to "1 K ohm, Variable, Clarostat, 57M-1K".

2. Page 6-3:

a. Add C18, "Capacitor, Fixed, Ceramic Dielectric, 0.01 uf, 1.6 kv, Central, DD16103".

b. Add C19, "Same as C18".

3. Page 6-4: Change J3 and J4 to "UG-1095".

4. Page 7-17:

a. Change wire on XA10B pin 6 to "XA10A pin 6"
XA10B pin 8 to "XA10A pin 8"
XA10A pin 8 to "XA10B pin 8"
XA10B pin 1 to "XA10A pin 1"
XA10A pin 1 to "XA10B pin 1".

b. Add C18 and C19, 0.01 uf capacitor from XV1 pin 3 to ground.

SH-211-1:

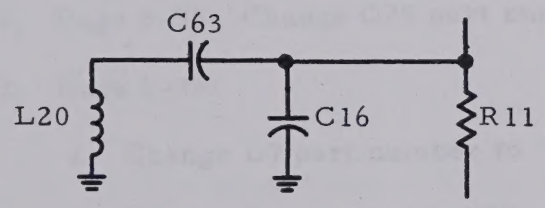
1. Page 6-13:

a. Change L6 part number to "2960-34-2".

b. Add L20 "Inductor, ACL, AB-024-44, 1".

2. Page 6-12: Add C63 "Capacitor, Fixed Mica Die, 10 pf ±5% 500 volt, Arco, DM-10-100J, 1".

3. Page 7-2: Add components per sketch below:



SH-213-1:

1. Page 6-22: Change C21 to "Capacitor, Ceramic, Disc, 1000 pf, ±20%, Sprague, 40C214A".

SH-204-2:

1. Page 6-27:

a. Change J2 to "FXR, 5116-058350".

b. Change L15 part number to "A-262-1".

CV-203:

1. Page 6-29:

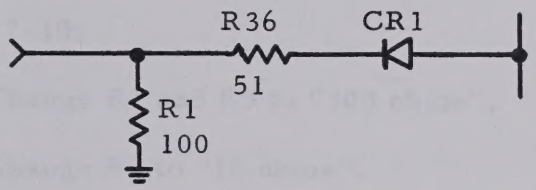
a. Change C9 to "1.5 pf, ±0.25 pf, Erie, 301-COJ-159C".

b. Change C10 to "12 pf, ±5%, Mica Dielectric, 500 WVDC, Elmenco, DM10-120".

2. Page 6-32: Change R7 to "470 ohms, ±5%, 1/4W, AB, CB4715".

3. Page 6-33: Add R36, "51 ohms, ±5%, 1/4W, AB, CB5105".

4. Page 7-6: Add R36 to schematic as shown below:



IF-221-3000:

1. Page 6-35: Change C25 part number to "150D156X0020B2".

2. Page 6-36:

a. Change L7 part number to "2960-37-2".

b. Change L9 quantity to "2".

c. Change L12 part number to "2960-34-2".

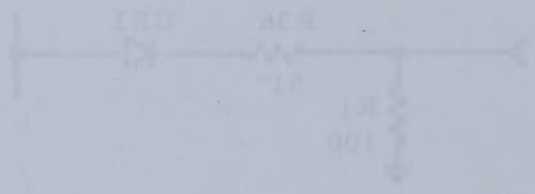
3. Page 6-37: Change P1 part number to "M7PRH19".

IF-211-75:

1. Page 6-47: Change C3 to "0.75 pf, ±10%, QC, MC-0.75".

2. Page 6-50:

a. Change R1 to "300 ohms, ±5%, 1/4W, AB, CB3015".



b. Change R2 to "18 ohms, ±5%, 1/4W, AB, CB1805".

3. Page 7-9:

a. Change R1 and R3 to "300 ohms".

b. Change R2 to "18 ohms".

c. Change C3 to "0.75 pf".

IF-211-150:

1. Page 6-52: Change C3 to "0.75 pf, ±10%, QC, MC-0.75".

2. Page 6-55:

a. Change R1 to "300 ohms, ±5%, 1/4W, AB, CB3015".

b. Change R2 to "18 ohms, ±5%, 1/4W, AB, CB1805".

3. Page 7-10:

a. Change R1 and R3 to "300 ohms".

b. Change R2 to "18 ohms".

c. Change C3 to "0.75".

AGC-204:

1. Page 6-57: Change CR3 part number to "1N752A".

2. Page 6-58: Change quantity of R3 to "5".

3. Page 7-11: Change CR3 part number to "1N752A".

IA-102:

1. Page 6-66:

a. Change quantity of CR1 to "1".

b. Change CR2 to "Semiconductor Device, Diode, Sylvania, 1N462, 1".

2. Page 7-15:

a. Mark polarity of C21, positive side goes to ground.

b. Change C15 to a fixed, rather than a variable capacitor.

c. Delete line on schematic going from the emitter of Q4 to junction of C18 and C19.

IFS-101:

1. Page 6-69:

a. Change quantity of C1 to "6".

b. Change quantity of C2 to "9".

c. Add tolerance of ±5% to C20, C22 and C23.

d. C24 is "35 WVDC, ±20%".

2. Page 6-70:

a. Change C27 to "Capacitor, Fixed, Dielectric, 0.01 uf, GMV500V, Sprague, 19C241, 2".

b. Change C29 to "Same as C27".

c. Change C31 to "Not Used".

d. Change C32 to "Not Used".

3. Page 6-79:

a. Add C51 "Same as C1".

b. Change CR1 to "Semiconductor Device, Diode, Fairchild, 1N916, 4".

4. Page 6-73: Change R7 to "75 ohms, ±5%, 1/4W, AB, CB7505, 1".

5. Page 6-74:

a. Change quantity of R22 to "10".

b. Change R29 to "Resistor, Fixed, Composition, 1.8 K, ±5%, 1 W, AB, GB1825, 2".

c. Change R30 to "Same as R29".

d. Change quantity of R38 to "2".

6. Page 6-75:

a. Change R61 to "Same as R38".

b. Add R62 "Same as R22".

c. Add R63 "Same as R22".

7. Page 7-16:

a. Remove components C31 and C32.

b. Add R62 across CR9.

c. Add R63 across CR10.

d. Change CR1, CR2, CR9, and CR10 to "1N916".

e. Change R7 to "75 ohms".

f. Positive side of C26 goes to ground.

g. Add a ground at junction of R27 and R26.

h. Add R61 and C51 as shown below:

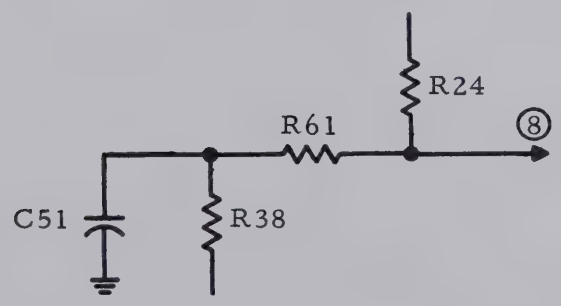


TABLE OF CONTENTS

Paragraph		Page
	SECTION I	
	GENERAL DESCRIPTION	
1.	Electrical Characteristics	1-2
2.	Mechanical Characteristics	1-3
3.	Accessories Supplied	1-5
	SECTION II	
	SPECIFICATIONS	
	Specifications	2-1
	SECTION III	
	OPERATION	
1.	General	3-2
2.	Connections	3-2
	A. Power	3-2
	B. Antenna Connection	3-2
	C. Video Output	3-3
	D. LO Output	3-3
	E. Audio Output	3-3
	F. Ground Connection	3-3
	G. AGC Output	3-3
	H. EXT Tuning Meter	3-4
3.	Operation	3-4

TABLE OF CONTENTS

Paragraph		Page
	SECTION III (Cont)	
3.	A. General Procedure	3-4
	B. Analysis of Modulation Characteristics	3-5
	C. AM Operation	3-6
	D. FM Operation	3-6
	E. CW Operation	3-7
	SECTION IV	
	THEORY OF OPERATION	
1.	Overall Operation	4-2
2.	30-100 Megacycle Tuner, SH-211-1	4-9
	A. RF Amplifier	4-9
	B. Mixer	4-10
	C. Local Oscillator	4-10
3.	90-260 Megacycle Tuning Head, SH-212-1	4-10
4.	250-500 Megacycle Tuning Head, SH-213-1	4-11
	A. RF Amplifier	4-11
	B. Mixer	4-12
	C. Local Oscillator	4-12
5.	490-1000 Mc Tuner, SH-204-2	4-13
	A. RF Preselector	4-13

TABLE OF CONTENTS

Paragraph		Page
	SECTION IV (Cont)	
5.	B. Local Oscillator	4-13
	C. Mixer	4-13
	D. IF Amplifier	4-14
6.	60-21.4 Megacycle Converter-Preamplifier, CV-203	4-14
	A. 60 Megacycle Amplifier	4-14
	B. 81.4 Megacycle Oscillator	4-14
	C. Mixer	4-14
	D. Preamplifier	4-15
7.	3 Megacycle Bandwidth IF Amplifier, A6 (IF-221-3000)	4-15
	A. 21.4 Megacycle Amplifiers	4-15
	B. AM Detector and Output Amplifier	4-16
	C. FM Limiters	4-16
	D. FM Discriminator	4-16
8.	20 Kilocycle Bandwidth IF Amplifier, A7 (IF-210-20)	4-16
	A. Mixer	4-16
	B. 19.75 Megacycle Crystal Controlled Oscillator	4-17
	C. 1.65 Megacycle Amplifier	4-17
	D. AM Detector and Output Amplifier	4-17
	E. Beat Frequency Oscillator	4-18

TABLE OF CONTENTS

Paragraph		Page
	SECTION IV (cont)	
8.	F. FM Limiter	4-18
	G. Discriminator and Output Amplifier	4-18
9.	75 Kilocycle Bandwidth IF Amplifier, A8 (IF-211-75)	4-18
10.	150 Kilocycle Bandwidth IF Amplifier, A9 (IF-211-150)	4-19
11.	AGC Amplifier, A10 (AGC-204)	4-19
12.	Video Amplifier, A11 (VA-202-1)	4-20
13.	Audio Amplifier, A12 (AA-101)	4-21
14.	Power Supply, A15 (PS-211)	4-21
	A. +12 and -12 Volt Power Supplies	4-22
	B. +24 Volt Power Supply	4-22
15.	Signal Display Unit	4-23
	A. Input Amplifier, A13 (IA-102)	4-23
	B. IF Amplifier and Sweep Oscillator, A14 (IFS-101)	4-24
	SECTION V	
	MAINTENANCE	
1.	General Information	5-1
2.	Special Test Equipment Considerations	5-3
	A. Test Probes	5-3
	B. Low-Sensitivity Multimeters	5-4

TABLE OF CONTENTS

Paragraph		Page
	SECTION V (Cont)	
2.	C. Transformerless Power Supplies	5-4
	D. Line Filters	5-5
3.	Transistor Test Procedures	5-5
	A. Replacement of Transistors in Operating Circuits	5-5
	B. Resistance Measurements in Transistor Circuits	5-5
	C. Testing Transistors with an Ohmmeter	5-6
4.	Module Repair	5-7
	A. Tools	5-7
	B. Soldering	5-8
	C. Printed Circuit Board Component Replacement	5-9
5.	Test Equipment Required	5-10
6.	Tuning Tapes and Gear Drives	5-14
7.	±12 Volt and 24 Volt DC Power Supplies, PS-211	5-15
	A. Normal Operating Voltages	5-15
	B. Power Supply Adjustment	5-16
8.	3 Mc Bandwidth IF Amplifier	5-16
	A. Normal Operating Voltages	5-16
	B. Alignment of 3 Mc Bandwidth IF Amplifier, IF-221-3000	5-17
	C. FM Alignment	5-19

TABLE OF CONTENTS

Paragraph		Page
	SECTION V (Cont)	
9.	20 Kc IF Amplifier, IF-210-20	5-21
	A. Normal Operating Voltages	5-21
	B. AM Alignment of the 20 Kc Bandwidth IF Amplifier	5-22
	C. FM Alignment of the 20 Kc Bandwidth IF Amplifier	5-24
10.	75 Kc Bandwidth IF Amplifier, IF-211-75	5-26
	A. Normal Operating Voltages	5-26
	B. Alignment of the 75 Kc Bandwidth IF Amplifier	5-27
	C. FM Alignment of the 75 Kc Bandwidth IF Amplifier	5-29
11.	150 Kc Bandwidth IF Amplifier, IF-211-150	5-31
	A. Normal Operating Voltages	5-31
	B. Alignment of the 150 Kc Bandwidth IF Amplifier	5-32
	C. FM Alignment of the 150 Kc Bandwidth IF Amplifier	5-34
12.	60-21.4 Mc Converter, CV-203	5-36
	A. Normal Operating Voltages	5-36
	B. Alignment of 60-21.4 Mc Converter, CV-203	5-37
	C. Alignment of CV-203, 21.4 Mc Preamplifier	5-39
13.	30-100 Mc Tuner, SH-211-1	5-41
	A. Normal Operating Voltages	5-41
	B. Alignment of the SH-211-1 Local Oscillator	5-42

TABLE OF CONTENTS

Paragraph		Page
	SECTION V (Cont)	
13.	C. Alignment of the SH-211-1 IF Amplifier	5-44
	D. Alignment of the SH-211-1, RF Amplifier	5-46
14.	90-260 Mc Tuner, SH-212-1	5-49
	A. Normal Operating Voltages	5-49
	B. Alignment of the SH-212-1 Local Oscillator	5-40
	C. Alignment of the SH-212-1 IF Amplifier	5-50
	D. Alignment of the SH-212-1 RF Amplifier	5-50
15.	250-500 Mc Tuner, SH-213-1	5-51
	A. Normal Operating Voltages	5-51
	B. Alignment of the SH-213-1 Local Oscillator	5-51
	C. Alignment of the SH-213-1 IF Amplifier	5-53
	D. Alignment of the SH-213-1 RF Amplifier	5-55
16.	490-1000 Mc Tuner, SH-204-2	5-58
	A. Normal Operating Voltages	5-58
	B. Alignment of the SH-204-2 Local Oscillator	5-59
	C. Alignment of the SH-204-2, 60 Mc IF Amplifier	5-59
	D. Crystal Current Adjustment	5-62
	E. RF Preselector	5-62
17.	AGC Module, AGC-204	5-62

TABLE OF CONTENTS

Paragraph		Page
	SECTION V (Cont)	
17.	A. Normal Operating Voltages	5-62
	B. AGC Threshold Adjustment of 3 Mc IF	5-64
	C. AGC Threshold Adjustment for Narrow Band IF	5-65
18.	Receiver Noise Figure Measurement	5-67
19.	Input Amplifier, IA-102	5-69
	A. Normal Operating Voltages	5-69
	B. Alignment of the IA-102 Input Amplifier	5-69
20.	IF Amplifier & Sweep Oscillator, IFS-101	5-71
	A. Normal Operating Voltages	5-71
	B. 4.3 Mc and 455 Kc IF Alignment	5-72
	C. Sweep Oscillator Alignment	5-73
	D. Final Check	5-75
21.	Other Measurements	5-76
22.	Troubleshooting	5-77
23.	Factory Repair Facilities	5-79
	SECTION VI	
	PARTS AND MANUFACTURERS LISTS	
1.	Parts List	6-1
2.	Manufacturers List	6-77

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

Figure		Page
1-1	SR-212 Receiver, Front Panel View	1-1
3-1	SR-212 Receiver, Rear Panel View	3-1
4-1	SR-212 Receiver, Functional Block Diagram	4-1
4-2	SR-212 Receiver, Top View	4-3
4-3	SR-212 Receiver, Bottom View	4-4
5-1	Test Configuration for IF-221-3000 Amplifier Alignment	5-18
5-2	Typical 3 Mc IF Amplifier Response	5-19
5-3	Typical 3 Mc IF Amplifier FM Response	5-20
5-4	20 Kc IF Bandwidth Amplifier Alignment Test Setup	5-22
5-5	20 Kc IF Amplifier AM Response	5-24
5-6	20 Kc IF Amplifier FM Response	5-26
5-7	75 Kc IF Amplifier AM Response	5-29
5-8	75 Kc IF Amplifier FM Response	5-31
5-9	150 Kc IF Amplifier AM Response	5-34
5-10	150 Kc IF Amplifier FM Response	5-36
5-11	Test Configuration for CV-203 Alignment	5-37
5-12	CV-203 Converter Response Curve	5-39
5-13	21.4 Mc Preamplifier Alignment	5-40
5-14	21.4 Mc Preamplifier Response Curve	5-41

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

Figure		Page
5-15	Test Setup for SH-211-1 Oscillator Alignment	5-43
5-16	Test Setup for SH-211-1 IF Alignment	5-44
5-17	Typical SH-211-1 IF Response	5-46
5-18	Test Setup for SH-211-1 RF Alignment	5-47
5-19	SH-211-1 RF Detector	5-47
5-20	Test Setup for SH-213-1 Oscillator Alignment	5-52
5-21	Test Setup for SH-213-1 IF Alignment	5-53
5-22	Typical SH-213-1 IF Response	5-55
5-23	Test Setup for SH-213-1 RF Alignment	5-56
5-24	Test Setup for SH-204-2 Alignment	5-60
5-25	SH-204-2, 60 Mc IF Response	5-61
5-26	Test Setup for AGC Adjustment	5-64
5-27	Test Setup for Noise Figure Measurement	5-67
5-28	Test Setup for IA-102 Input Amplifier Alignment	5-70
7-1A	SH-211-1 Tuner, 30-100 Mc	7-2
7-1B	SH-211-1 Tuner, 30-100 Mc, Schematic	7-2
7-2A	SH-212-1 Tuner, 90-260 Mc	7-3
7-2B	SH-212-1 Tuner, 90-260 Mc, Schematic	7-3
7-3A	SH-213-1 Tuner, 250-500 Mc	7-4
7-3B	SH-213-1 Tuner, 250-500 Mc, Schematic	7-4

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

Figure		Page
7-4A	SH-204-2 Tuner, 490-1000 Mc	7-5
7-4B	SH-204-2 Tuner, 490-1000 Mc, Schematic	7-5
7-5A	CV-203 Converter, 60-21.4 Mc	7-6
7-5B	CV-203 Converter, 60-21.4 Mc, Schematic	7-6
7-6A	IF-221-3000,3 Mc Bandwidth IF Amplifier	7-7
7-6B	IF-221-3000, 3 Mc Bandwidth IF Amplifier, Schematic	7-7
7-7A	IF-210-20, 20 Kc Bandwidth IF Amplifier	7-8
7-7B	IF-210-20, 20 Kc Bandwidth IF Amplifier, Schematic	7-8
7-8A	IF-211-75, 75 Kc Bandwidth IF Amplifier	7-9
7-8B	IF-211-75, 75 Kc Bandwidth IF Amplifier, Schematic	7-9
7-9A	IF-211-150, 150 Kc Bandwidth IF Amplifier	7-10
7-9B	IF-211-150, 150 Kc Bandwidth IF Amplifier, Schematic	7-10
7-10A	AGC-204, AGC Amplifier	7-11
7-10B	AGC-204, AGC Amplifier, Schematic	7-11
7-11A	VA-202-1, Video Amplifier	7-12
7-11B	VA-202-1, Video Amplifier, Schematic	7-12
7-12A	AA-101, Audio Amplifier	7-13
7-12B	AA-101, Audio Amplifier, Schematic	7-13
7-13A	PS-211, ±12 VDC & +24 VDC Power Supply	7-14
7-13B	PS-211, ±12 VDC & +24 VDC Poser Supply, Schematic	7-14

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

Figure		Page
7-14A	IA-102, Input Amplifier	7-15
7-14B	IA-102, Input Amplifier, Schematic	7-15
7-15A	IFS-101, IF Amplifier & Sweep Oscillator	7-16
7-15B	IFS-101, IF Amplifier & Sweep Oscillator, Schematic	7-16
7-16	SR-212 Interconnection Diagram	7-17

LIST OF TABLES

Table		
5-1	Required Test Equipment Characteristics	5-10
5-2	PS-211 Transistor Voltages	5-15
5-3	3 Mc Bandwidth IF Amplifier Transistor Voltages	5-17
5-4	20 Kc Bandwidth IF Amplifier Transistor Voltages	5-21
5-5	IF-211-75 Transistor Voltages	5-27
5-6	IF-211-150 Transistor Voltages	5-32
5-7	CV-203 Transistor Voltages	5-37
5-8	SH-211-1 Transistor Voltages	5-42
5-9	SH-212-1 Transistor Voltages	5-50
5-10	SH-213-1 Transistor Voltages	5-51
5-11	SH-204-2 Transistor Voltages	5-58
5-12	AGC-204 Transistor Voltages	5-63
5-13	IA-102 Transistor Voltages	5-69

TABLE OF CONTENTS

LIST OF TABLES

Table		Page
5-14	IFS-101 Transistor Voltages	5-72
5-15	SR-212 Main Chassis Voltages	5-76
5-16	Cathode Ray Tube Pin Voltages	5-77
5-17	AA-101 Transistor Voltages	5-77
5-18	VA-202-1 Transistor Voltages	5-77
5-19	Troubleshooting Chart	5-77

Figure 1-1. SR-212 Receiver, Front Panel View

SECTION I

GENERAL DESCRIPTION

1. Electrical Characteristics.

The SR-212 is a compact surveillance receiver employing solid state devices and modular design techniques. The equipment is used for the simultaneous detection and display of either AM, FM or CW signals.

The system operates over the VHF/UHF frequency spectrum from 30-1000 megacycles. Four tuning bands are provided: 30-100, 90-260, 250-500, and 490-1000 megacycles. The desired tuning range is selected by a front panel switch.

Four IF bandwidths of 20, 75, 150 kilocycles and 3 megacycles are provided. The 20, 75, and 150 kilocycle IF bandwidths are selected by a front panel switch, while the 3 megacycle bandwidth is in the circuit at all times.

Two methods of gain control are incorporated into the design of the receiver, manual and automatic (AGC). During AM operation, manual and automatic gain control are selected by the position of a switch on the front panel. When the switch is in the AM/MAN position, receiver gain is controlled by the RF GAIN control on the front panel. When the switch is in the AM/AGC position, the gain of the receiver is automatically controlled to provide a nearly constant output level over the dynamic range of the receiver. During the CW mode of operation, the gain of the receiver can

only be controlled manually. For FM signal reception, AGC is mandatory.

A beat frequency oscillator (BFO) is included on all three narrow band IF amplifier printed circuit cards to provide an audio beat output during CW signal reception. Operation of the BFO is controlled by the front panel controls marked BFO TUNING and FINE TUNING and the main tuning dial. The BFO is energized in the CW mode when the IF bandwidth selector switch is in any of the three positions.

The signal to which the receiver is tuned is displayed on a spectrum display unit (SDU). The display unit operates on a center frequency of 21.4 megacycles. The first IF of the unit is derived by mixing the input signal with that of a 25.7 megacycle sweep oscillator to provide an IF of 4.3 mcs. The first IF is then heterodyned with a crystal controlled oscillator of 4.755 megacycles to provide a final IF of 455 kilocycles. The sweep rate is a constant 20 cycles per second. A 21.4 megacycle crystal marker is provided for center frequency adjustments.

The receiving system operates on an input voltage of 115 vac, 50 to 400 cps, single phase. The maximum power consumption is 30 watts.

2. Mechanical Characteristics.

The SR-212 receiving system has two basic functions, detection and display. Controls and switches associated with the detection function include: FM-AM/AGC-AM/MAN-CW mode selection, RF GAIN, TUNING RANGE MC, IF BANDWIDTH KC, POWER-ON, AUDIO GAIN, BFO TUNING, FINE TUNING and VIDEO GAIN.

Associated with the TUNING RANGE MC selector switch there are four direct-reading, frequency indicating tape dials. Each dial is recessed behind a transparent protective window. The dials are illuminated according to the position of the TUNING RANGE MC selector switch. A tuning knob is placed below each window for frequency tuning. Relative signal strength of the incoming signal is indicated on a SIGNAL STRENGTH meter. A phone jack on the front panel of the receiver is provided for aural monitoring of the signals to which the receiver is tuned.

Controls and indicators associated with the display function consist of MKR-ON, SWEEP WIDTH, CENTER FREQ, and GAIN. The spectrum characterisitcs of the input signal to the receiver are displayed on a 1 inch by 3 inch cathode-ray tube.

All input and output connections are made from the back panel of the receiver. These include seven BNC connectors labeled J1, ANT INPUT 30-1000 MC, J2, ANT INPUT 90-260 MC, J9, WB FM VIDEO OUTPUT, J8, WB AM VIDEO OUTPUT, J5, LO OUTPUT 30-260 MC, J6, LO OUTPUT 250-1000 MC, J7, NB VIDEO OUTPUT and two type N connectors labeled J3, ANT INPUT 250-500 MC and J4, ANT INPUT 490-1000 Mc. A six-barrier terminal strip provides connections for AUDIO OUTPUT 600 OHMS, GND, AGC OUT and EXT TUNING METER. A three-wire power cord is permanently attached to the back of the receiver. A fuse holder labeled 1 AMP SLOW BLOW is provided.

Construction of the front, back, side panels, and main deck of the

receiver is of aluminum which permits light weight construction while maintaining maximum structural strength. All characters on the front of the receiver are etched-engraved on a clear hard anodized satin finish aluminum overlay. The etched-engraved markings are filled with black enamel for ease in readability. Both top and bottom dust covers can be slid into position along two pairs of slots milled on the side panels and anchored into a slot on the rear of the front panel. Two pairs of 1/4 turn Camloc fasteners are used to fasten the dust covers to the back of the receiver. The four RF tuners, the converter preamplifier, and the 3 Mc IF subassembly are constructed of brass, silver plated, and gold flashed. This technique minimizes interference effects, assures good RF grounding, and prevents tarnishing. All other subassemblies are designed in the form of plug-in printed circuit boards. These include the IF amplifiers, the AGC amplifier, the video amplifier, the audio amplifier, the power supplies, the input amplifier and sweep oscillator sections of the signal display unit. The dimensions of the unit are 3-1/2" H x 19" W x 17-1/4" D. Protective handles are provided on both the front and rear panels.

3. Accessories Supplied.

The unit is shipped with an instruction manual, a power cord adapter and all necessary alignment tools. The alignment tools are mounted within the unit by spring clips.

SECTION II

SPECIFICATIONS

Frequency Tuning Range	Continuously tunable, 30 to 1000 mc in 4 bands Band A: 30-100 mc Band B: 90-260 mc Band C: 250-500 mc Band D: 490-1000 mc
Type of Reception	AM, FM and CW
Input Impedance	50 ohms nominal, all bands
Antenna Connections	Located on rear panel of receiver Band A: Type BNC Band B: Type BNC Band C: Type N Band D: Type N
Noise Figure	Band A: 4.5 db maximum Band B: 7.0 db maximum Band C: 10 db maximum Band D: 12 db maximum
Intermediate Frequency	Band A: 1st 21.4 mc, 2nd 2.5 mc (75, 150 kc BW) 2nd 1.65 mc (20 kc BW) Band B: 1st 21.4 mc, 2nd 2.5 mc (75, 150 kc BW) 2nd 1.65 mc (20 kc BW) Band C: 1st 60 mc, 2nd 21.4 mc, 3rd 2.5 mc (75, 150 kc BW) 3rd 1.65 mc (20 kc BW) Band D: 1st 60 mc, 2nd 21.4 mc, 3rd 2.5 mc (75, 150 kc BW) 3rd 1.65 mc (20 kc BW)
Intermediate Frequency Rejection .	Band A: 53 db minimum below 40 mc 60 db minimum above 40 mc Band B: 90 db minimum Band C: 90 db minimum Band D: 90 db minimum

Image Rejection	Band A: 60 db minimum Band B: 50 db minimum Band C: 65 db minimum Band D: 80 db minimum
Oscillator Radiation	Band A: 5 microvolts maximum Band B: 15 microvolts maximum below 260 mc Band C: 5 microvolts maximum Band D: 50 microvolts maximum
IF Bandwidth	Band A: 20, 75, 150 kc and 3 mc Band B: 20, 75, 150 kc and 3 mc Band C: 20, 75, 150 kc and 3 mc Band D: 20, 75, 150 kc and 3 mc
AM Sensitivity	Band A and B 20 Kc Bandwidth: 2 uv input, modulated 50% at 1 kc rate, shall produce 17 db S+N/N minimum Band C and D 20 Kc Bandwidth: 4 uv input, modulated 50% at 1 kc rate, shall produce 17 db S+N/N minimum Band A and B 75 Kc Bandwidth: 4 uv input, modulated 50% at 1 kc rate, shall produce 16 db S+N/N minimum Band C and D 75 Kc Bandwidth: 8 uv input, modulated 50% at 1 kc rate, shall produce 16 db S+N/N minimum Band A and B 150 Kc Bandwidth: 4 uv input, modulated 50% at 1 kc rate, shall produce 13 db S+N/N minimum Band C and D 150 Kc Bandwidth: 8 uv input, modulated 50% at 1 kc rate, shall produce 13 db S+N/N minimum Band A and B 3 Mc Bandwidth: 14 uv input, modulated 50% at 1 kc rate, shall produce 10 db S+N/N minimum

AM Sensitivity (Cont)	Band C and D 3 Mc Bandwidth: 28 uv input, modulated 50% at 1 kc rate, shall produce 10 db S+N/N minimum
FM Sensitivity	Band A and B 20 Kc Bandwidth: 2 uv input, modulated at 1 kc rate with 7 kc deviation shall produce 21 db S+N/N minimum
	Band C and D 20 Kc Bandwidth: 4 uv input, modulated at 1 kc rate with 7 kc deviation, shall produce 21 db S+N/N minimum
	Band A and B 75 Kc Bandwidth: 3 uv input, modulated at 1 kc rate with 25 kc deviation, shall produce 21 db S+N/N minimum
	Band C and D 75 Kc Bandwidth: 6 uv input, modulated at 1 kc rate with 25 kc deviation, shall produce 21 db S+N/N minimum
	Band A and B 150 Kc Bandwidth: 4 uv input, modulated at 1 kc rate with 50 kc deviation, shall produce 21 db S+N/N minimum
	Band C and D 150 Kc Bandwidth: 8 uv input, modulated at 1 kc rate with 50 kc deviation, shall produce 21 db S+N/N minimum
	Band A and B 3 Mc Bandwidth: 14 uv input, modulated at 1 kc rate with 1 mc deviation, shall produce 21 db S+N/N minimum
	Band C and D 3 Mc Bandwidth: 28 uv input, modulated at 1 kc rate with 1 mc deviation, shall produce 21 db S+N/N minimum

AM Stability all Bandwidths	Band A and B: Less than 7 db variation for input range of 70 db above 3.5 microvolts. Band C and D: Less than 7 db variation for input range of 70 db above 2.0 microvolts
FM Stability all Bandwidths	Band A and B: Less than 2 db variation for inputs above 2 microvolts Band C and D: Less than 2 db variation for inputs above 4 microvolts
Audio Amplifier Response	Less than 3 db variation from 250 cycles per second to 20 kc
Audio Power Output	100 milliwatt minimum into 600 ohm load unbalanced 10 milliwatt minimum at phone jack
Video Amplifier Response	Less than 3 db variation from 250 cycles per second to 4 mc
Video Amplifier Output	5 volt peak to peak maximum output into a 93 ohm load
BFO	Operable with 20 kc, 75 kc, 150 kc bandwidth BFO pitch: ±20 kc minimum, using TUNING control, FINE TUNING control, and BFO control
Signal Display Unit	CRT size, standard 1" by 3" display
Sweepwidth	From dc to 3 mc continuously adjustable
Resolution	10 kc
IF Frequency	First IF: 4.3 mc Second IF: 455 kc
Amplitude Response	±1.5 db within any sweepwidth, excluding effects of preceding tuner

Sensitivity	1.5 microvolt at any RF input produces at least 1" deflection with sweep width control set to approximately 50 kc
Crystal Marker	21.4 mc center frequency marker
Linearity	1% within sweepwidth
Weight	Approximately 40 pounds
Dimensions	3-1/2" H x 19" W x 17-1/4" D
Power Input	115 vac, 50-400 cps, single phase
Power Consumption	25 watts approximately
Finish	Gray enamel per MIL-E-15090, Color No. 26329, Federal Standard 595

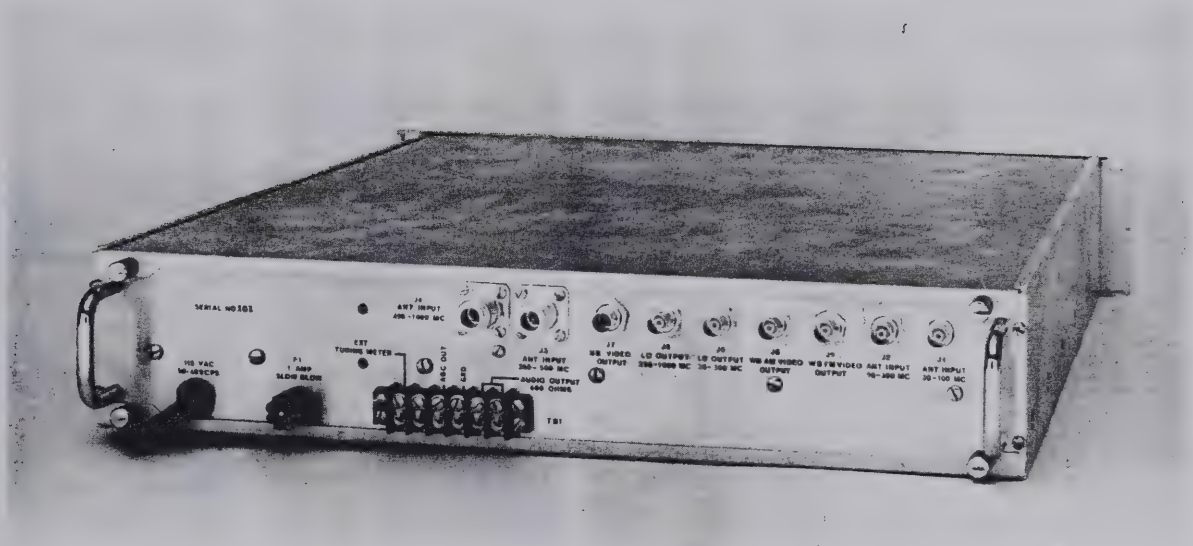


Figure 3-1. SR-212 Receiver, Rear Panel View

SECTION III

OPERATION

1. General.

The SR-212 Receiver is designed for mounting in a standard 19 inch rack. All controls required for operation of the receiver are located on the front panel. In addition, a phone jack is provided for aural monitoring of the receiver's operation. All connections to the receiver are made on the back panel. Due to the receiver's low power consumption, no special cooling system is required.

2. Connections.

A. Power: Plug the power cord to a 115 volt ac, 50 to 400 cps source which has a third connection for grounding. A three-prong to two-prong power cord adapter is supplied with the receiver in the event a three-prong receptacle is not available.

B. Antenna Connection: Connect a 50 ohm coaxial cable to the type N or type BNC connector according to the desired range of operation. For operation from 30 to 100 mc, connect the cable to J1 ANT INPUT; for operation from 90 to 260 mc, connect the cable to J2 ANT INPUT; for operation from 250 to 500 mc, connect the cable to J3 ANT INPUT; and for operation from 490 to 1000 mc, connect the cable to J4 ANT INPUT. Antennas may be connected to all four inputs simultaneously, no external switching being required.

C. Video Output: Three video outputs are provided for connection to remote monitoring equipment. The outputs available are J7, NB VIDEO OUTPUT, J8, WB AM VIDEO OUTPUT, and J9, WB FM VIDEO OUTPUT. Connect the remote video monitoring equipment to the desired BNC connector with a 93 ohm coaxial cable.

D. LO Output: Two BNC local oscillator output connectors are provided for connection to frequency monitoring equipment. J5 is associated with tuning bands A and B and is used for local oscillator outputs over the frequency range from 30 to 260 mc. J6 is associated with tuning bands C and D and is used for local oscillator outputs over the frequency range from 250 to 1000 mc. For proper impedance matching, connection to the local oscillator output connectors shall be made using a 50 ohm coaxial cable which is terminated in a 50 ohm load.

E. Audio Output: Connect the speaker to terminals 5 and 6 of the barrier strip TB1 with a pair of leads. For an unbalanced connection, connect a jumper between terminal 6 and terminal 4. Terminal 4 is grounded to the receiver chassis. In the event that the speaker does not have an impedance of 600 ohms, a matching transformer is required.

F. Ground Connection: Terminal 4 of barrier strip TB1 is provided for the ground connection of any equipment using the outputs of the barrier strip.

G. AGC Output: Terminal 3 of barrier strip TB1 has a negative going voltage which is proportional to the input signal strength. The voltage

can be used for remote monitoring of the input signal strength. The minimum permissible load resistance for this output is 10 K ohms.

H · EXT Tuning Meter: Terminal 1 of barrier strip TB1 is provided to permit connection to a remote tuning meter. (100-0-100 microamps).

3. Operation.

A. General Procedure: The following operation procedure applies to either AM, FM or CW modes of operation.

(1) Place the POWER switch in the ON position, and one of the four tape dials will be illuminated. Allow a few minutes for the cathode ray tube filaments to warm-up.

(2) Select the frequency band desired with the TUNING RANGE MC switch.

(3) Use the tuning knob directly below the illuminated tape dial for frequency tuning.

(4) Select the IF bandwidth of either 20, 75 or 150 with the IF BANDWIDTH KC switch.

(5) Use the AUDIO GAIN control to adjust the audio level at both the output terminals and the phone jack.

(6) Use the video GAIN control to adjust the level of the NB video outputs. Advancing the control in the clockwise direction increases the output level.

(7) The SIGNAL STRENGTH meter indicates only the relative level of the carrier and is not calibrated in any special units.

(8) The cathode ray tube displays the spectrum characteristics of the input signal and the following adjustments should be made accordingly.

a. The MKR-ON switch should be turned off for initial operation.

b. The GAIN control provides adjustment of the amplitude of the signals displayed on the CRT screen.

c. The SWEEP WIDTH control determines the magnitude of excursion of the sweep oscillator from its center frequency and therefore the coverage of frequency spectrum as displayed on the CRT screen. As a general practice, set the control to its furthest clockwise position for maximum sweep width when searching for signals or studying the activities around the desired signal. To analyze the type of modulation of the desired signal or any particular adjacent signal, reduce the sweep width by turning the control in the counter-clockwise direction to a convenient point for observation of the desired signal.

d. The CENTERING control determines the center frequency of the sweep oscillator and therefore the relative position of the incoming signal with respect to the trace. For normal operation, the center of sweep should correspond to the center of the incoming signal which is 21.4 mc. To set the CENTERING control, turn on the MKR switch and move the 21.4 mc marker to the center of the screen while reducing the SDU gain as required.

B. Analysis of Modulation Characteristics:

(1) A CW signal appears as a single deflection, just like the built-in marker.

(2) An AM signal appears as a deflection of varying amplitude. The upper and the lower sidebands start appearing when the modulation exceeds 5 to 10 kcs.

(3) An FM signal appears as a train of deflections corresponding to the carrier and all adjacent pairs of sidebands. At a constant modulation rate, the separation between any two adjacent deflections represents the modulation rate. The relative amplitude of the carrier and the sidebands depend on the carrier modulation index. At certain deviation indices the carrier disappears; this carrier null visual indication can aid in calibrating FM signal generators or FM transmitters. In addition, at certain modulation indices selected sideband pairs will null, permitting more sophisticated FM deviation calibration possibilities.

C. AM Operation:

(1) Set the mode switch in the AM/AGC position.

(2) Set the IF BANDWIDTH switch to the desired IF bandwidth.

(3) Tune the frequency knob for a desired signal.

(4) With the aid of the spectrum display unit, tune the signal to the center of the band. When the receiver is correctly tuned in the signal shall be at the center of the cathode-ray tube and the SIGNAL STRENGTH meter shall register a peak indication.

(5) Adjust the AUDIO and the VIDEO GAIN controls for the desired output levels.

(6) Should manual operation be desired, place the mode selector switch in the AM/MAN position. In this position the RF GAIN control is adjusted to avoid saturation of the RF and IF amplifiers and to give the desired output levels.

D. FM Operation:

(1) Set the mode switch in the FM position.

(2) Repeat procedures (2) through (5) in paragraph C. Manual gain control is not possible in the FM mode of operation.

E. CW Operation:

(1) Set the mode switch in the CW position.

(2) Set the IF BANDWIDTH switch in the 20 kilocycle position. The BFO is now in the circuit for all positions of the IF BANDWIDTH KC switch.

(3) In CW operation, only manual gain control is possible. Therefore, the RF GAIN control should be used to prevent saturation of the RF and IF amplifiers and to give the desired output level.

(4) Repeat procedures (3) through (5) in paragraph C.

(5) Use the BFO TUNING and FINE TUNING controls to tune for a beat signal audio tone on the earphones. On some tuning ranges, and especially on Bands A & B, the main tuning control associated with the tuning indicator tape should be adjusted to give the desired beat note.

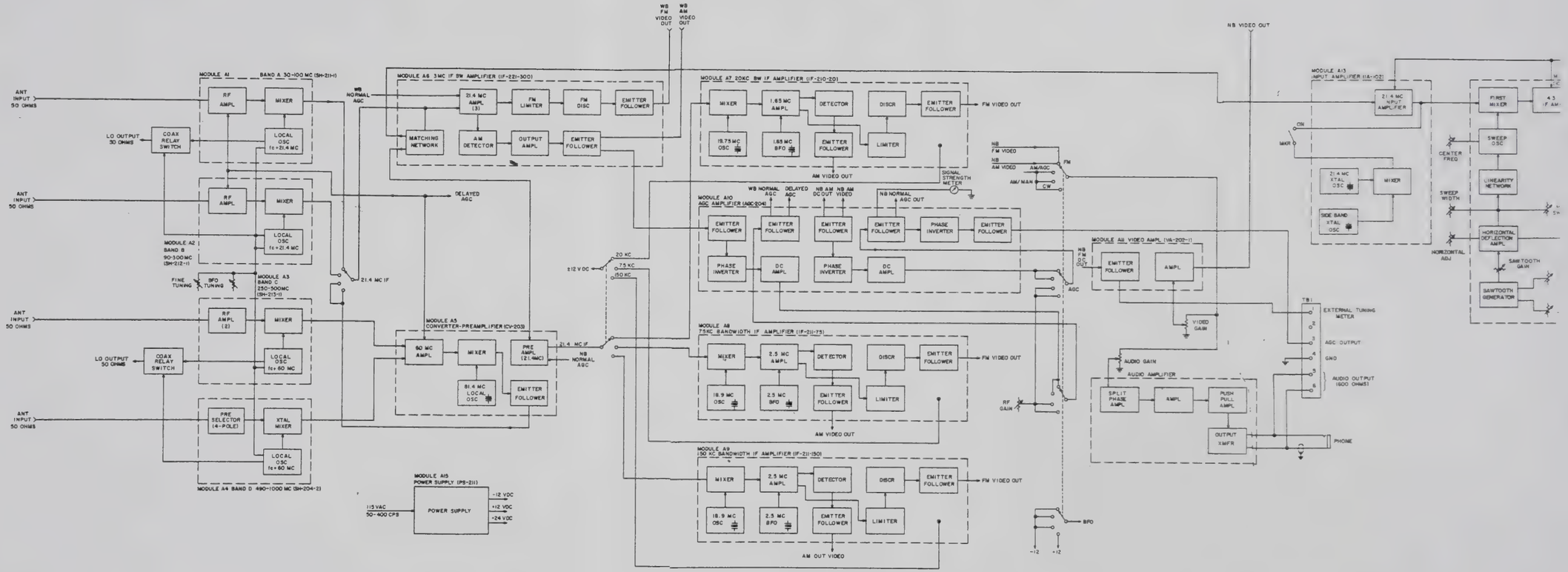


Figure 4-1. SR-212 Receiver, Functional Block Diagram

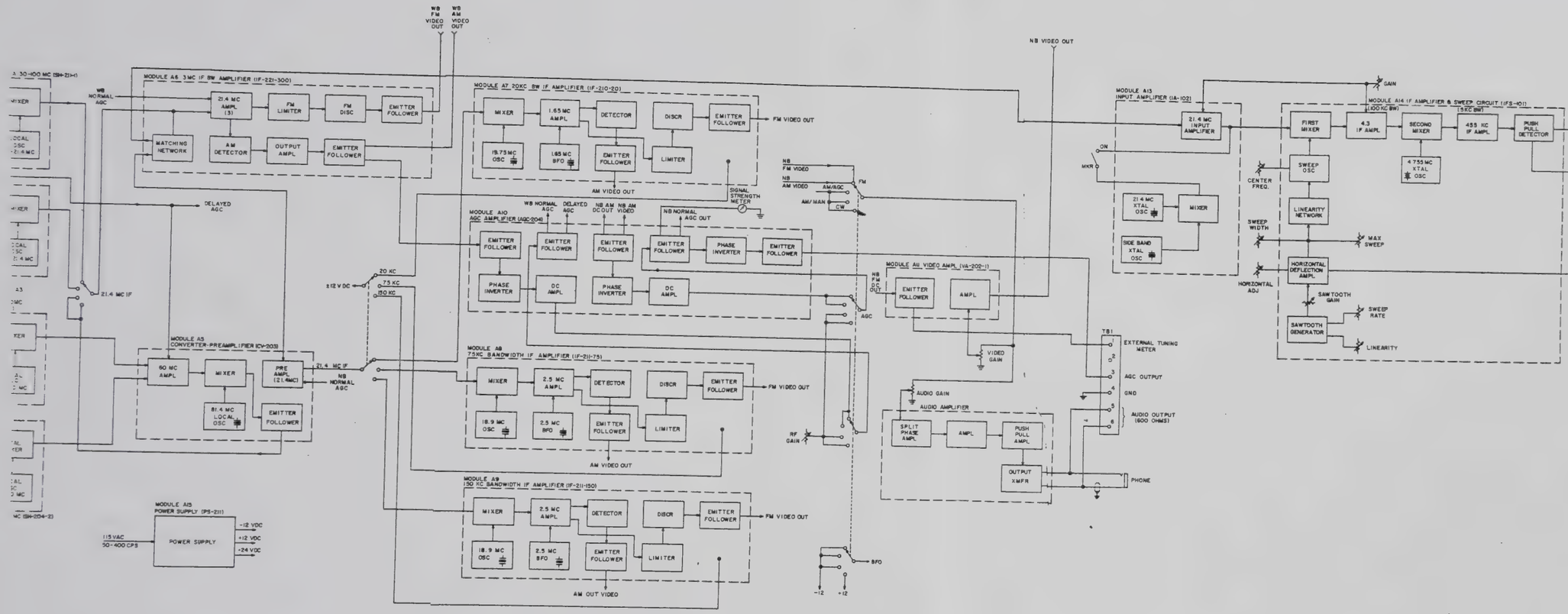
SECTION IV

THEORY OF OPERATION

1. Overall Operation.

The SR-212 receiver is a general purpose surveillance equipment used for the simultaneous detection and display of RF signals. A functional block diagram of the receiver is illustrated in Figure 4-1. The receiver covers the VHF/UHF frequency spectrum in four bands, 30-100, 90-260, 250-500 and 490-1000 megacycles. The receiver is capable of FM, AM and CW operation. Four IF bandwidth amplifiers of 20, 75, 150 kilocycles and 3 megacycles are provided. Selection of tuning range, IF bandwidth, mode of operation, marker generator, and mode of gain control during AM operation is accomplished by front panel selector switches. Frequency tuning, BFO TUNING, RF GAIN, VIDEO GAIN, AUDIO GAIN, SWEEPWIDTH, GAIN and center frequency adjustments are provided by front panel controls. An insulated PHONES jack is located on the front panel for audio monitoring. All other inputs and outputs are located on the rear panel of the receiver. Video outputs and LO outputs are in the form of type BNC receptacles located on the rear panel of the receiver. Connections for EXT TUNING METER, AGC, GND and AUDIO OUTPUT are located on a six-terminal barrier strip.

The received signal is coupled from the antenna to one (1) of four (4) RF tuning heads through a 50 ohm coaxial cable. Each RF tuner has an


WB FM VIDEO OUT
WB AM VIDEO OUT
NB VIDEO OUT
MODULE A6 3 MC IF BW AMPLIFIER (IF-221-300)
21.4 MC AMPL (3)
FM LIMITER
FM DISC
EMITTER FOLLOWER
MATCHING NETWORK
AM DETECTOR
OUTPUT AMPL.
EMITTER FOLLOWER
WB NORMAL AGC
MODULE A7 20KC BW IF AMPLIFIER (IF-210-20)
MIXER
1.65 MC AMPL
DETECTOR
DISCR
EMITTER FOLLOWER
FM VIDEO OUT
19.75 MC OSC
1.65 MC BFO
EMITTER FOLLOWER
LIMITER
AM VIDEO OUT
SIGNAL STRENGTH METER
NB FM VIDEO
NB AM VIDEO
AM/AGC
AM/MAN
CW
FM
MODULE A10 AGC AMPLIFIER (AGC-204)
WB NORMAL AGC
DELAYED AGC
NB AM DC OUT
NB AM VIDEO
NB NORMAL AGC OUT
EMITTER FOLLOWER
PHASE INVERTER
DC AMPL
MODULE A11 VIDEO AMPL (VA-202-1)
EMITTER FOLLOWER
AMPL
NB FM DC OUT
AGC
MODULE A13 INPUT AMPLIFIER (IA-102)
21.4 MC INPUT AMPLIFIER
GAIN
ON
MKR
21.4 MC XTAL OSC
MIXER
SIDE BAND XTAL OSC
MODULE A14 IF AMPLIFIER & SWEEP CIRCUIT (IFS-101)
(100 KC BW)
(5 KC BW)
FIRST MIXER
4.3 IF AMPL
SECOND MIXER
455 KC IF AMPL
PUSH PULL DETECTOR
VERT ADJ
SWEEP OSC
4.755 MC XTAL OSC
CENTER FREQ.
LINEARITY NETWORK
SWEEP WIDTH
MAX SWEEP
HORIZONTAL DEFLECTION AMPL.
HORIZONTAL ADJ
SAWTOOTH GAIN
SAWTOOTH GENERATOR
SWEEP RATE
LINEARITY
CRT
INT
FOCUS
115 V AC
CRT POWER SUPPLY
1200 V REG
150 V REG
6.3 V REG
TB1
EXTERNAL TUNING METER
AGC OUTPUT
GND
AUDIO OUTPUT (600 OHMS)
PHONE
AUDIO GAIN
AUDIO AMPLIFIER
SPLIT PHASE AMPL
AMPL
PUSH PULL AMPL
OUTPUT XMFR
VIDEO GAIN
RF GAIN
BFO
-12
+12
MODULE A5 CONVERTER-PREAMPLIFIER (CV-203)
30-100 MC (SM-210-1)
DELAYED AGC
21.4 MC IF
20 KC
7.5 KC
150 KC
+12 V DC
60 MC AMPL
MIXER
PRE AMPL (21.4MC)
81.4 MC LOCAL OSC
EMITTER FOLLOWER
NB NORMAL AGC
MODULE A8 75 KC BANDWIDTH IF AMPLIFIER (IF-211-75)
MIXER
2.5 MC AMPL
DETECTOR
DISCR
EMITTER FOLLOWER
FM VIDEO OUT
18.9 MC OSC
2.5 MC BFO
EMITTER FOLLOWER
LIMITER
AM VIDEO OUT
MODULE A9 150 KC BANDWIDTH IF AMPLIFIER (IF-211-150)
MIXER
2.5 MC AMPL
DETECTOR
DISCR
EMITTER FOLLOWER
FM VIDEO OUT
18.9 MC OSC
2.5 MC BFO
EMITTER FOLLOWER
LIMITER
AM OUT VIDEO
MODULE A15 POWER SUPPLY (PS-211)
115 VAC 50-400 CPS
POWER SUPPLY
-12 VDC
+12 VDC
+24 VDC

SECTION IV

THEORY OF OPERATION

1. Overall Operation.

The SR-212 receiver is a general purpose surveillance equipment used for the simultaneous detection and display of RF signals. A functional block diagram of the receiver is illustrated in Figure 4-1. The receiver covers the VHF/UHF frequency spectrum in four bands, 30-100, 90-260, 250-500 and 490-1000 megacycles. The receiver is capable of FM, AM and CW operation. Four IF bandwidth amplifiers of 20, 75, 150 kilocycles and 3 megacycles are provided. Selection of tuning range, IF bandwidth, mode of operation, marker generator, and mode of gain control during AM operation is accomplished by front panel selector switches. Frequency tuning, BFO TUNING, RF GAIN, VIDEO GAIN, AUDIO GAIN, SWEEPWIDTH, GAIN and center frequency adjustments are provided by front panel controls. An insulated PHONES jack is located on the front panel for audio monitoring. All other inputs and outputs are located on the rear panel of the receiver. Video outputs and LO outputs are in the form of type BNC receptacles located on the rear panel of the receiver. Connections for EXT TUNING METER, AGC, GND and AUDIO OUTPUT are located on a six-terminal barrier strip.

The received signal is coupled from the antenna to one (1) of four (4) RF tuning heads through a 50 ohm coaxial cable. Each RF tuner has an

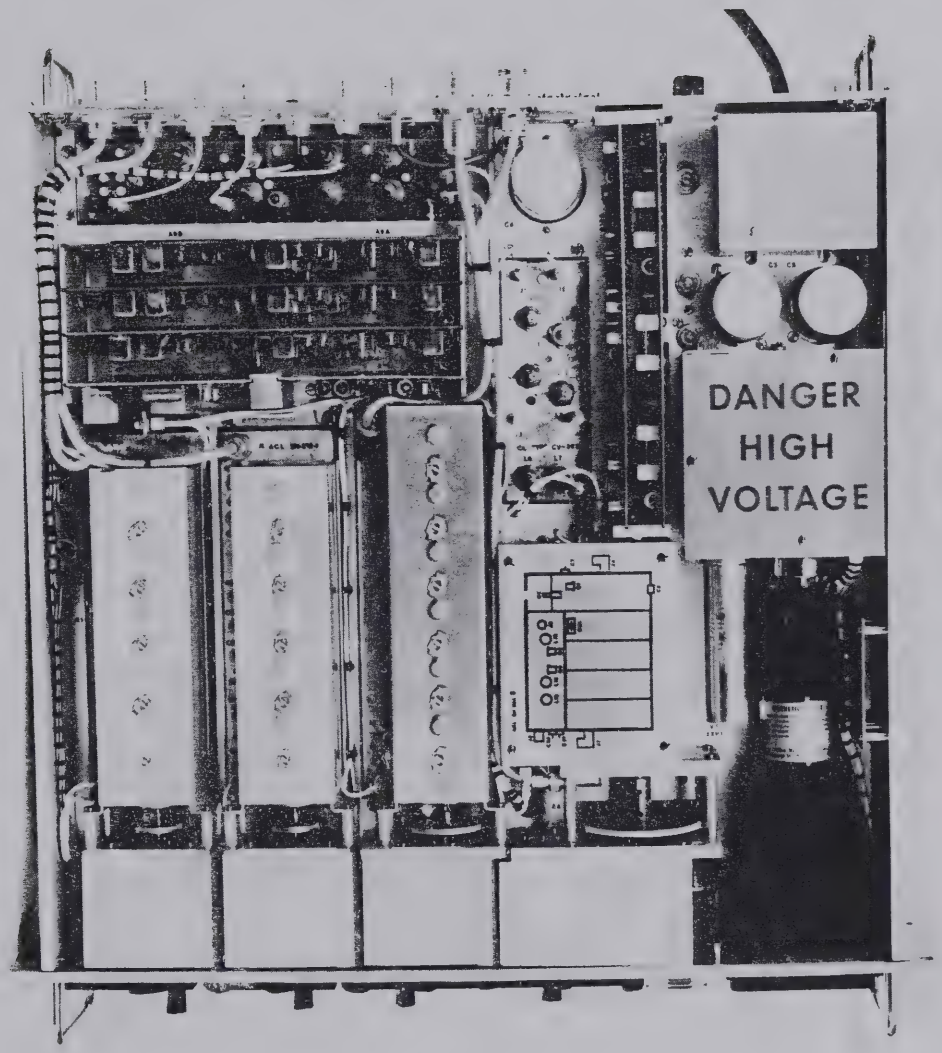


Figure 4-2. SR-212 Receiver, Top View

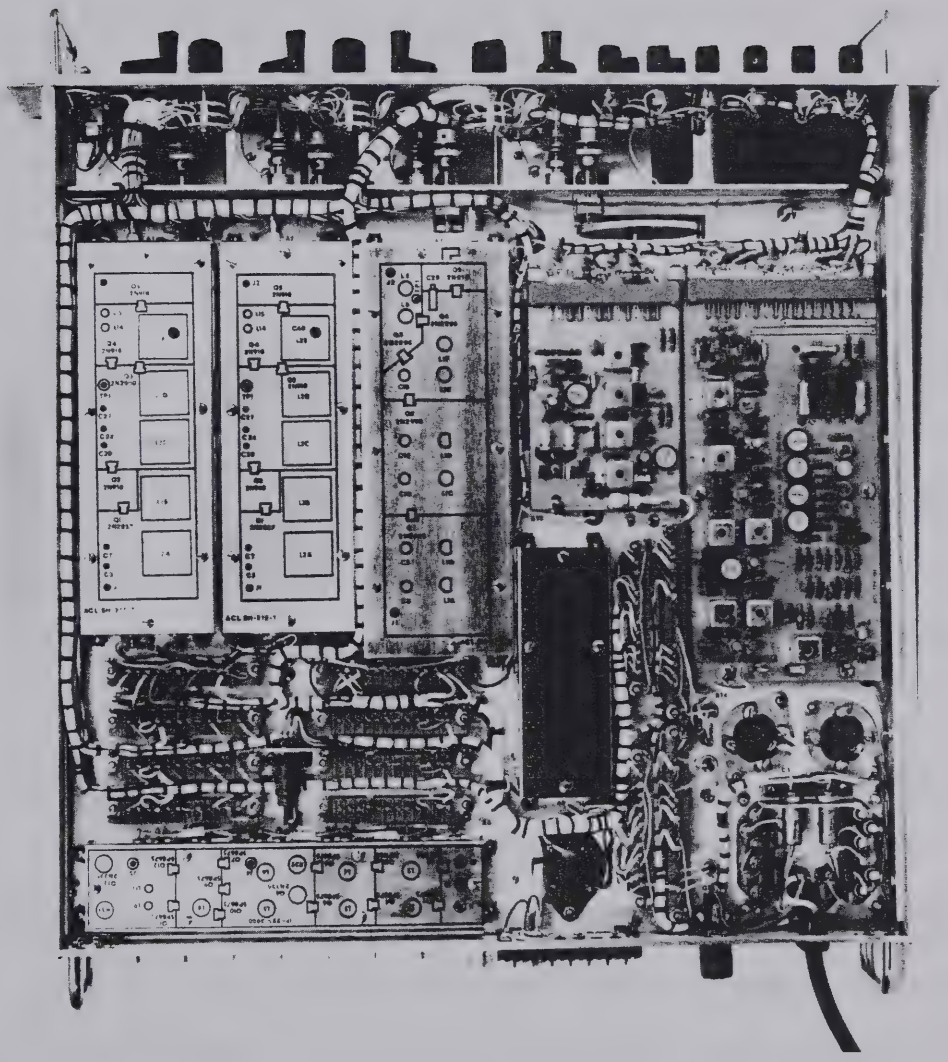


Figure 4-3. SR-212 Receiver, Bottom View

associated type BNC or type N RF input connector. For Bands A and B, which provide tuning over the 30 to 260 megacycle frequency range, type BNC connectors are used. For Bands C and D, which provide tuning over the 250 to 1000 megacycle frequency range, type N connectors are used.

Band A and B RF tuners incorporate in their design an RF amplifier, a mixer, and a local oscillator. Both Band A and Band B RF tuners are designed to provide an IF frequency of 21.4 mcs, therefore, the local oscillator frequency is always 21.4 mcs above the frequency to which the RF amplifier is tuned. The output of the Band A and B tuner is an IF signal centered at 21.4 megacycles with a bandwidth of 3 megacycles, and a signal coupled from the local oscillator. The 21.4 megacycle signal is fed directly through a switch to the 3 megacycle IF amplifier. Band A and B local oscillator outputs are fed to a common BNC connector, J5, located on the rear panel of the receiver. Tuning of the incoming signal is accomplished by a six-turn, five-section inductuner.

Band C RF tuner contains two RF amplifier stages, a mixer and a local oscillator. The local oscillator is designed so that its frequency is always 60 megacycles above the carrier frequency. By the heterodyning action of the local oscillator and the mixer the input RF signal is converted to a 60 megacycle IF signal which is fed to a converter-preamplifier for further conversion to 21.4 mcs.

Band D RF tuner contains a four (4) pole preselector, a crystal mixer, a local oscillator and a 60 megacycle amplifier. Like Band C the

the output of the tuner is a 60 megacycle IF signal which is fed to the converter-preamplifier.

These UHF tuners have a common local oscillator output connector, J6, which is available at the rear panel of the receiver.

The 21.4 megacycle output signal of Band A and B RF tuners is fed to the 3 megacycle IF amplifier. Here the signal is amplified and demodulated. The 3 megacycle IF amplifier is in the circuit at all times. The 3 megacycle IF amplifier contains three (3) IF amplifier stages followed by an AM and FM demodulator. AGC is applied to the first two amplifier stages to increase the dynamic range of the receiver. The wideband AM and FM video signal is fed to BNC connectors located on the rear panel of the receiver. These connectors are labeled J8 and J9, respectively. The 21.4 megacycle input signal is also fed through a matching network to the 21.4 megacycle preamplifier which drives the three narrow band IF amplifiers.

The 60 megacycle IF outputs from Band C and D RF tuners are fed to the converter-preamplifier subassembly, where the signal is amplified, converted to 21.4 megacycles, and fed to the 3 megacycle IF bandwidth amplifier. Delayed AGC is applied to the 60 megacycle amplifier stage to increase the dynamic range of the receiver. The signal then returns to the 21.4 megacycle preamplifier where it is amplified and fed again to the 20, 75 and 150 kilocycle IF channels. The output signal from the converter-preamplifier is 21.4 megacycles with a bandwidth of 500 kilocycles.

The converter-preamplifier consists of cascode amplifiers, a crystal controlled oscillator, a mixer and tuning circuits.

The path of the signal as it leaves the converter preamplifier is controlled by the position of the IF bandwidth selector switch. The 20, 75 and 150 kilocycle IF bandwidth channels each employs an identical number of stages in their design. Each channel contains an oscillator, a mixer, an amplifier, a detector, a beat frequency oscillator, two output amplifiers, a limiter, a discriminator, and associated tuned circuits. The 21.4 megacycle input signal to the IF channels is first mixed with a crystal controlled oscillator. After mixing, the difference frequency is amplified, detected, and fed to an emitter follower. The emitter follower supplies AM video to appropriate circuits of the receiver. A beat frequency oscillator is provided in each IF channel. It is crystal controlled and operates only when the mode selector switch is in the CW position. From the IF amplifier section the IF signal is applied to a limiter whose function is to remove the AM from the signal. This signal is then applied to a discriminator whose output is fed to an emitter follower. The emitter follower supplies FM video to appropriate circuits of the receiver. The output signals of the IF channels are fed to the AGC amplifier, the video amplifier, and the audio amplifier during AM, FM and CW operating modes.

The AGC amplifier consists of two similar circuit modules. Each module consists of emitter followers, a phase inverter and an amplifier. The AGC amplifier provides all gain control voltages for the IF amplifiers

and tuners. One portion of the AGC amplifier supplies normal AGC to the 3 megacycle IF bandwidth amplifier, and delayed AGC voltage to the 60 megacycle amplifier portion of the converter-preamplifier and the RF tuners when operating in Bands A and B. The other portion of the AGC amplifier controls the 21.4 megacycle preamplifier, the selectable NB IF amplifiers, drives the signal strength meter, and supplies a signal to terminal board TB1 for external AGC monitoring.

The demodulated output of the 20, 75 and 150 kilocycle IF bandwidth amplifiers is coupled to the audio amplifier and the video amplifier by the IF BANDWIDTH KC switch and the mode selector switch on the front panel. Both audio and video amplifiers are fabricated on plug-in circuit boards. Audio and video gain controls are provided on the front panel. The output of the audio transformer delivers 100 milliwatts minimum into a 600 ohm balanced load. The output of the video amplifier is 5 volts peak-to-peak maximum into a 93 ohm load.

Three power supplies are required for operation of the receiver: +12 vdc, -12 vdc, and +24 vdc. Each power supply is regulated and individually fused. The 12 volt supplies are identical in construction and circuitry. Opposite voltage polarity is obtained by grounding opposite ends of the power supplies to the main chassis. The power supplies are mounted on one printed circuit card with the associated series regulators and filter capacitors mounted nearby on the main chassis.

The signal display unit provides a visual display of the signal spectrum

to which the receiver is tuned. The input signal to the display unit is supplied from the outputs of the tuners or converter at 21.4 megacycles. Like a general purpose laboratory oscilloscope, the signal display unit contains a CRT and associated switches and controls, such as focus, intensity, horizontal and vertical positioning etc; an input amplifier, and an IF amplifier and sweep oscillator are also included.

2. 30-100 Megacycle Tuner, SH-211-1.

A. RF Amplifier: The RF amplifier for Band A tuner consists of two low noise n-p-n transistors connected in cascode. These transistors are labeled Q1 and Q2 on the SH-211-1 tuning head schematic diagram. The RF amplifier is gain controlled to increase the dynamic range of the receiver. Forward AGC voltage, derived from the AGC amplifier AGC-204, is connected to the base of Q1 through resistor R5 and R2. The input signal is coupled to the base of the RF amplifier by a double-tuned circuit consisting of L2A and L2B. These circuits constitute the first two sections of a five-section inductuner. L1 and L4 provide tracking adjustments for the high end of the band while C5 and C7 provide tracking adjustments for the low end of the band. A matching impedance network consisting of C18, L7 and C54 match the collector of Q1 to the emitter of Q2, a common base stage. The collector circuit of transistor Q2 is tuned over the frequency range by the 3rd and 4th sections of the five-section inductuner labeled L2C and L2D respectively. L8 and L10 provide tracking adjustments for the high end of the band while capacitors C20 and C24 provide tracking

adjustments for the low end of the band. C21 and C28 are fixed tank capacitors. The output of the double tuned circuit is capacitively coupled to the base of Q3 by capacitor C29.

B. Mixer: The RF mixer consists of two silicon transistors, a 2N2950, Q3, and a 2N918, Q4, connected in cascode. The output circuit of the mixer contains a double tuned circuit consisting of L14, L15, C35 and C37. This circuit is tuned to the IF of 21.4 megacycles and has a bandwidth of 3 megacycles as measured at the half power points. Test point TP1 is provided for checking and aligning the response of the circuit.

C. Local Oscillator: Band A RF tuner employs Q5, a 2N918 silicon transistor in a Colpitts circuit as the local oscillator. The frequency of the local oscillator is always 21.4 megacycles above the carrier frequency. L2E, the fifth section of the inductuner, provides tuning of the local oscillator. The local oscillator signal is applied from the base of Q5 trhough cpacitor C39 to the mixer. L16 provides a high band tracking adjustment and C49 provides a low band tracking adjustment. Capacitor C52 couples the oscillator signal to external connector J5. Resistive pad R31, R32, and R33 provide a 50 ohm match for connection to a 50 ohm cable for local oscillator monitoring. BFO tuning is provided by varying the collector voltage of the local oscillator Q5.

3. 90-260 Megacycle Tuning Head, SH-212-1.

The theory of operation of Band B RF tuner is comparable to the theory of operation of the Band A RF tuner. Operation over a higher

frequency range has necessitated the replacement of mixer Q3, with a 2N918 transistor. In addition, the method of obtaining proper tuner tracking has been changed by the addition of components, and their change in numerical value. It may be noted in the Band B RF tuner that small values of inductances have been added in parallel to all sections of the inductuner with the exception of L2E which remains the same.

4. 250-500 Megacycle Tuning Head, SH-213-1.

A. RF amplifier: The RF amplifier for Band C tuner consists of two high gain low noise transistor stages connected in cascade. These transistors are labeled Q1 and Q2 on the SH-213-1 tuning head schematic diagram. The base of each transistor is grounded. Neutralization for each stage is accomplished by feeding an out of phase signal from the low side of the collector tuned circuit to the input. C8 and C16 are the neutralizing capacitors for Q1 and Q2, respectively. The incoming signal received is coupled to the emitter of the RF amplifier by a double-tuned circuit consisting of L1A and L1B. These tuned circuits utilize the first two sections of a six-section inductuner. Tracking adjustments for the high end of the band are accomplished by the careful positioning of L2 and L3. Tracking adjustments for the low end of the band are accomplished by C3 and C5. The input to the second RF amplifier is tuned by the third and fourth sections of the six-section inductuner L1C and L1D. Variable capacitors C11 and C14 provide low end tracking adjustments for this tuned circuit. The output of the second RF amplifier stage is coupled to the mixer

by a single tuned circuit. Section five of the six-section inductuner L1E is used to tune this stage. Tracking adjustments can be made by varying C18.

B. Mixer: The mixer circuit includes two 2N2996 transistors, Q3 and Q4, connected in cascode. The output of the mixer contains a double tuned circuit, tuned to the IF frequency, 60 megacycles. The circuit can be tuned by varying L8 and L9. This circuit has a bandwidth of 4.5 megacycles as measured at the half power points. TP1 provides a test point for connecting an oscilloscope with associated detector to check and align the response of the circuit.

C. Local Oscillator: Band C RF tuner employs a 2N918 transistor, Q5, in a balanced Colpitts circuit as the local oscillator. The circuit is designed to provide a local oscillator frequency which is always 60 megacycles above the carrier frequency. L1F, the sixth section of the inductuner provides tuning of the local oscillator. The local oscillator signal is applied from the collector of Q5 through L10 and C20 to the base of Q3. Tracking adjustments for the local oscillator are provided on the high end of the band by the careful positioning of L11 and on the low end by varying C29. Capacitor C45 couples the oscillator signal to external connector J6. Resistive pad, R18, R19 and R21 provide isolation and a 50 ohm match for the 50 ohm coaxial output cable. BFO TUNING and FINE TUNING are provided by varying the collector voltage of the local oscillator, Q5.

5. 490-1000 Mc Tuner, SH-204-2.

A. RF Preselector: The RF preselector for Band D tuner consists of four high Q, one-quarter wavelength tuned coaxial lines. These lines are labeled L2, through L5 on the SH-204-2 tuning head schematic diagram. Iris coupling is provided between each of the four cavities. Alignment of each individual cavity is accomplished by varying the shape of capacitors C2 through C5. Preselector tuning is accomplished by varying the ganged loading capacitors, C1A through C1D through an angle of 180°. L1 matches the preselector to a 50 ohm input impedance. The output of the preselector is matched to crystal mixer CR1 through L6.

B. Local Oscillator: The local oscillator for Band D is a 2N2616 silicon transistor, Q1. A 1/2 wavelength transmission line is used as the tuning element. The frequency of the local oscillator is always 60 megacycles above the desired RF frequency. Tuning is provided by loading capacitor C1E, which is ganged to C1D. The high end frequency (1060 megacycles) and low end frequency (550 megacycles) are fixed by the adjustments of two trimmer capacitors, C6 and C9, respectively. A regulated power supply is used to enhance stable oscillator operation. L15 couples part of the local oscillator energy out at J4 for sampling purposes.

C. Mixer: The mixer for Band D tuning head is a 1N82A silicon mixer diode designated CR1. The RF and local oscillator signals are coupled to the crystal mixer through L6. L10 matches the output of the mixer to the IF amplifier input at 60 megacycles.

D. IF Amplifier: The 60 megacycle IF amplifier consists of two 2N2996 low noise germanium transistors connected in cascode. These transistors are designated Q2 and Q3. The output circuit contains a double tuned circuit whose 3 db bandwidth is approximately 4.5 megacycles. The output circuit is matched to a 50 ohm load.

6. 60-21.4 Megacycle Converter-Preamplifier, CV-203.

A. 60 Megacycle Amplifier: The input 60 megacycle amplifier consists of a 2N3287 and an SP8675 transistor connected in cascode. The transistors are designated Q1 and Q2. The output from the Band C and Band D tuners are fed to the converter input at J1 and J2 respectively. Diodes CR1 and CR2 located at the input to the converter are biased in such a way that only the output signal of the operating tuner is permitted to reach Q1. Q1 provides a forward gain control range of from 30 to 40 db. The output of the 60 megacycle amplifier contains a double tuned circuit consisting of C5, L1, C7, L2 and C8. The tuned circuit is coupled to the base of Q3 by coupling capacitor, C9.

B. 81.4 Megacycle Oscillator: The converter employs an SP8675 transistor Q6 as a high beat local oscillator. The local oscillator signal mixes with the 60 mc IF signal in transistor mixer Q3 to produce a 21.4 mc output frequency. The 81.4 megacycle local oscillator frequency is crystal controlled to assure a high degree of stability. The local oscillator signal is applied to the base of Q3 through capacitor C10.

C. Mixer: The mixer circuit contains a 2N918 and an SP8675

transistor connected in cascode. These transistors are designated Q3 and Q4, respectively. A cascode configuration is used in this stage to minimize the effects of output circuit loading on the 60 megacycle amplifier stage. The output of the mixer contains a double tuned circuit consisting of C12, L3, C14, L4, and C15. The output of the tuned circuit is applied to an SP8675 transistor Q5 operating as an emitter follower. The output of the emitter follower is fed via J3 to the 3 megacycle IF amplifier.

D. Preamplifier: The preamplifier consists of a 2N3289, Q7, and an SP8675, Q8, transistor connected in cascode. The input to the preamplifier is applied at J4 to the base of Q7. Normal AGC is applied to the base of Q7. The output of Q7 is applied to the emitter of Q8 through coupling capacitor C25. The output of Q8 contains a double tuned circuit. Tuning is performed by L6 and L7. The output of the preamplifier is fed via J5 to the 20, 75, and 150 kilocycle IF amplifiers according to the position of the IF BANDWIDTH KC selector switch.

7. 3 Megacycle Bandwidth IF Amplifier, A6 (IF-221-3000).

A. 21.4 Megacycle Amplifiers: The 3 megacycle IF bandwidth amplifier contains 3 double tuned amplifier stages connected in cascade. Each stage employs two transistors connected in cascode. The components of the amplifier stage include two 2N3289 transistors, Q1 and Q3, and four SP8675 transistors, Q2, Q4, Q5, and Q6. Normal AGC is applied to the base of the common emitter transistor of the first two stages, Q1 and Q3. The output of Q6 is applied to the AM detector and the first FM limiter.

B. AM Detector and Output Amplifier: The AM detector and output amplifier consists of a 1N198A rectifier, CR3, and an SP8675 and a 2N335 transistor designated Q7 and Q8 respectively. CR3 detects the signal output from Q6 and applies the video information to emitter follower Q7. The output of Q7 is fed to another emitter follower Q8. From the emitter of Q8 the detected AM video information is applied to J4 for purposes of external monitoring. A variable potentiometer located in the base circuit of Q8 provides amplitude adjustment of the output AM video signal.

C. FM Limiters: The FM limiter consists of two SP8675 transistors designated Q9 and Q10 respectively. The output of Q6 drives the first limiter Q9. A tuned circuit is contained in the output stage of the second limiter Q10. Q10 drives the FM discriminator.

D. FM Discriminator: The FM discriminator consists of an SP8675 transistor, Q11, and associated circuitry. The discriminator is of the Foster-Seeley type. The signal from the discriminator is applied to emitter follower Q12. Q13 is also an emitter follower with a variable resistor connected in the base circuit to provide adjustment of its FM output. The output of Q13 is connected to J5 for external monitoring.

8. 20 Kilocycle Bandwidth IF Amplifier A7 (IF-210-20).

A. Mixer: The 21.4 megacycle input signal from the converter-preamplifier is applied to the base of a cascode mixer. The mixer consists of two SP8675 transistors designated Q2 and Q3, respectively. The input circuit of Q2 contains a double tuned circuit and a resistive pad, R1

R2, and R3. The mixer output consists of a 1.65 megacycle center frequency double-tuned circuit whose output is directly coupled to the base of Q4, the 1.65 megacycle amplifier.

B. 19.75 Megacycle Crystal Controlled Oscillator: The crystal controlled oscillator consists of an SP8675 transistor, Q1, and a 19.75 megacycle crystal, Y1. The oscillator is operated in a grounded-collector Colpitts configuration. The output of the oscillator is coupled to the input of the mixer Q2 through C9.

C. 1.65 Megacycle Amplifier: The 1.65 megacycle IF signal from the mixer is amplified to a level adequate to operate the AM detector. Amplification of the signal is performed by two SP8675 transistors connected in cascode. The amplified signal is simultaneously coupled by a double tuned circuit to the AM detector, CR2, and the input to the FM limiter.

D. AM Detector and Output Amplifier: The AM detector, CR2, is a 1N87A diode. Filter capacitors C28 and C31 filter the carrier out of the desired detected signal. The polarity of the AM detector is such that the average dc output is in the positive going direction with an increase of input signal strength. The detected output is coupled to output amplifier Q7, an SP8675 transistor. This amplifier, connected as an emitter follower, presents a high impedance to the AM detector. Therefore, with its ac load approximating its dc load, 100 percent modulation can be performed without bottom clipping. The detected AM output of Q7 is fed to the video

and audio amplifiers during the AM mode of operation.

E. Beat Frequency Oscillator: The beat frequency oscillator consists of an SP8675 transistor Q6 and a 1.65 megacycle crystal Y2. The oscillator is in a Colpitts circuit configuration. The BFO signal is applied to the AM detector through C22. The BFO is energized when the mode selector switch is in the CW position.

F. FM Limiter: The FM limiter consists of two SP8675 transistors Q8 and Q9. The input to the limiter is tapped from the secondary of the double-tuned circuit just prior to signal detection. The two transistors of the limiter circuit are connected in cascode. The output of the limiter provides a constant drive to the FM demodulator through a wideband single-tuned circuit.

G. Discriminator and Output Amplifier: The FM demodulator is a Travis discriminator. All coupling elements are capacitors. The demodulated signal is fed to Q10, an emitter follower, whose output is applied to the video and audio amplifiers during FM operation.

9. 75 Kilocycle Bandwidth IF Amplifier A8 (IF-211-75).

The 75 kilocycle bandwidth IF amplifier uses an identical number of stages as that of the 20 kilocycle bandwidth IF amplifier. The difference between these IF amplifiers is in the frequency of crystals Y1 and Y2. To convert the input 21.4 megacycle IF frequency to 2.5 megacycles the frequency of Y1 has been changed to 18.9 megacycles. The frequency of Y2 has been changed to 2.5 megacycles. The basic circuit theory described

in Section IV paragraph 8 is applicable to the theory of operation of the 75 kilocycle bandwidth IF amplifier.

10. 150 Kilocycle Bandwidth IF Amplifier A9 (IF-211-150).

The 150 kilocycle bandwidth IF amplifier is identical to the 75 kilocycle bandwidth IF amplifier with the exception of changes in the components of tuned circuits necessary to provide the 150 kilocycle bandwidth. For the theory of operation of the 150 kilocycle bandwidth amplifier refer to Section IV, 8.

11. AGC Amplifier, A10 (AGC-204).

The AGC amplifier consists of two similar AGC amplifier circuits on a common printed circuit board. One circuit supplies normal AGC to the 3 megacycle IF bandwidth amplifier and delayed AGC to the RF amplifiers. The other circuit supplies AGC to the 21.4 megacycle preamplifier which precedes the 20, 75, and 150 kilocycle IF bandwidth amplifiers. Seven n-p-n transistors and four diodes make up one AGC amplifier circuit. The dc signal from the AM detector is applied directly to the base of Q1, a type 2N697 transistor. Q1 and Q2 are emitter followers connected in cascade. Q2 is also a type 2N697 transistor. The output of Q2 is directly coupled through CR1, a 1N753A Zener diode, to Q3, a 2N335 transistor serving as a phase inverter. The modulated output of Q3 is filtered to a dc ripple by video filter C3. Q4, a 2N697 transistor, provides high gain amplification of the input signal. The output signal of Q4 is directly in phase with the input signal at emitter follower Q1. Potentiometer R9,

connected to the base of Q4, is the AGC threshold control. Q5 and Q6 are emitter followers connected in cascade. The emitter followers provide the AGC output and the delayed AGC output. When the AGC voltage at the input of Q5 is extremely low, the voltage at the AGC output may become negative. CR2 then becomes forward biased and the AGC output is maintained at a minus 0.2 volt level. This voltage serves as a minimum AGC output voltage reference. The maximum output voltage is approximately 12 volts. Zener diode CR3 provides a 3 volt delay of the AGC voltage applied to the RF tuning heads and the converter. This delay prevents the deterioration of signal to noise ratio during the reception of low level signals.

Nine transistors are used in the sectond AGC circuit. The theory of operation of this circuit is identical to the previous AGC circuit discussed up to emitter follower Q13. The output of Q13 is applied to the AGC output, the signal strength meter, and to Q14. Q14 inverts the signal and feeds it to emitter followers Q15 and Q16. The output of Q16 is applied to TB1, terminal 6, for external monitoring.

12. Video Amplifier, A11 (VA-202-1).

The video amplifier circuit board consists of two separate circuits. The demodulated output from the operating IF strip is applied to Q1, an emitter follower. The output of Q1 is fed to TB1 for connection of an external tuning meter. The demodulated FM or AM signal is fed to the input of Q2 through appropriate switches and controls. Amplifier Q2 and Q3

form a feedback pair. Current feedback is provided from the unbypassed emitter of Q3 to the base of Q2 through R5. Resistor R5 determines the amount of feedback. The overall gain of the amplifier pair is approximately 20 db.

13. Audio Amplifier, A12 (AA-101).

The audio amplifier circuit board, AA-101, consists of a split phase amplifier Q1 and Q2, a push pull amplifier Q3 and Q4, and two transformers T1 and T2. The signal from the AUDIO GAIN control is fed to the base of Q1 via R1 and C1. The amplified signal at the collector of Q1 is directly coupled to pin 1 of T1; however, the attenuated signal at the emitter of Q1 is fed to the grounded base amplifier Q2 to provide an output which is equal in magnitude to the output signal at Q1 but opposite in polarity. Thus, in essence, Q1 and Q2 operate like a push pull amplifier. The primary of the output transformer is driven from the collector of Q3 and Q4. The secondary of the output transformer has both 600 ohm balanced and 150 ohm unbalanced outputs.

14. Power Supply, A15 (PS-211).

The power supply circuitry of the receiver delivers +12, -12, and +24 volt dc outputs. The ±12 volt outputs are supplied by identical circuits, the opposite ends of which are grounded. All power supplies are physically located on one printed circuit board. Each power supply is individually fused. The series regulator transistor and the filter capacitor for each power supply is mounted on the main chassis adjacent to the board.

A. +12 and -12 Volt Power Supplies: CR1 through CR4 form a full wave bridge rectifier circuit whose output is approximately 18 volts unregulated. Regulation to ±12 volts is provided by a control amplifier, Q2, a driver, Q1, and the chassis mounted series regulator. Resistive divider network R4, R5, R6 and R7 forms the sensing circuit of the regulator. R5 is initially adjusted to provide either +12 or -12 volts at the output of the supply under full load conditions. With a change in either load or line conditions, any increase in voltage is transmitted to the base of Q1 by the sensing network. As the potential between the base and the referenced emitter rises, the current through Q2 increases and is accompanied by a voltage drop at the collector. Since the collector of Q2 is tied to the base of Q1, the collector current of Q1 is decreased at the same time. Because the emitter of Q1 is connected to the base of the series regulator, the series regulator is driven toward cutoff. As a result, the voltage drop across the regulator increases, and the supply output voltage is brought back to either +12 or -12 volts.

B. +24 Volt Power Supply: The +24 volt power supply is a simple Zener controlled circuit with no error voltage amplification included. CR1 through CR4 form a full wave bridge rectifier circuit. A filter capacitor, located on the main chassis and connected to the output of the bridge rectifier, together with R8, R9, C6 and C7, provide the filtering action. The combination of Zener diodes CR2 and CR3 provides a 25 volt reference source and is connected directly to the base of the emitter follower Q3.

The emitter of Q3 is then clamped at 24.4 volts, which, in turn, is the base voltage of the series regulator transistor. There is approximately 0.4 vdc drop across the base-emitter function of the series regulator transistor and the output of the supply is thus 24 vdc.

15. Signal Display Unit.

A. Input Amplifier, A13 (IA-102): The input amplifier consists of a 2N3289 and an SP8675 transistor, Q1 and Q2, in a cascode configuration. The cascode configuration provides low noise high gain operation without the sacrifice of stability. Because of the high isolation between the input and the output, no neutralization is required. The input signal is coupled to the base of transistor Q1 via a double-tuned circuit. The primary of the input coupling network consists of inductor L1 and capacitors C1 and C2. The signal is coupled to the secondary of the circuit by coupling capacitor C3. The secondary resonant circuit consists of inductor L2 and capacitors C4 and C5. C4 and C5 also match the impedance of the input network to the input of the first transistor. After the signal is amplified by the two transistors, it is applied to the output double tuned circuit in the collector of Q2. The primary of this network consists of inductor L3 and resonating capacitor C9. C10 couples the primary to the secondary of the tuned network. The secondary circuit consists of L4 and resonating capacitors C12 and C14. C12 and C14 comprise two arms of a pi network and match the impedance of the tuned circuit to the low input impedance of the next stage on the IF Amplifier and Sweep Circuit card, IFS-101.

The signal from the marker generator is applied to the low side of the secondary. The gain of the input amplifier is controlled by varying the gain of transistor Q1. This gain variation is achieved by changing the base bias applied through resistor R2 from the gain control potentiometer, R13, located on the front panel of the unit.

Both center frequency and sideband marker generators are provided in the signal display unit. The center frequency marker is generated by transistor Q1, located on the Input Amplifier (IA-102), while the sideband markers are generated by transistor Q2. Both circuits operate in a Colpitts configuration. Each signal display unit contains a 21.4 megacycle crystal supplied to generate the center frequency marker in conjunction with Q1. This crystal is designated Y1. Although the circuitry is provided for the sideband markers, a crystal is not normally installed in the crystal holder designated for Y2. Crystals of the user's choice may be installed either at the factory at the time of manufacture or in the field as required. Resistor R7 permits a limited range of adjustment of the sideband markers to assure that they display the correct amplitude on the scope trace. Diodes CR1 and CR2 mix the center frequency and the sideband markers to provide a modulated signal to the marker input terminal of the IF Amplifier and Sweep Circuit card, IFS-101. Switch S1 permits the application of power to the marker circuits at the discretion of the operator.

B. IF Amplifier and Sweep Oscillator, A14 (IFS-101): The sweep

oscillator, Q8, is an n-p-n transistor connected in a Colpitts configuration with its output frequency swept across a range of at least 3 megacycles by means of a voltage variable capacitor, CR7, a "varicap". The varicap is a semiconductor device whose effective capacitance varies as the reciprocal of the square root of the dc voltage applied across it. It is connected in series with the oscillator tank circuit and controls the oscillator frequency by varying the tank circuit series capacitance.

The dc voltages which vary the capacitance of CR7 are derived from two sources. One source comes from R14, the frequency CENTERING control through terminal 10 on the IFS-101 card. Potentiometer R14 is part of a voltage divider circuit located between +150 volts dc and ground. The circuit consists of R38 and Zener regulator CR8. The fixed bias to CR7 may be adjusted to vary the sweep oscillator center frequency approximately ±250 kilocycles from the center frequency.

The other voltage applied to the varicap is an ac sawtooth waveform. The source of this ac voltage is the horizontal sweep circuitry. When this signal is applied to CR7 it varies the sweep oscillator frequency in sychronization with the horizontal sweep of the cathode ray beam. The amplitude of the sawtooth applied to the varicap, and hence the sweepwidth of the local oscillator, is controlled by MAX SWEEP control R59 and SWEEP WIDTH control R16. The former control is used for alignment purposes. The latter control is mounted on the front panel. R59 is adjusted so that when the SWEEP WIDTH control is at maximum, the local

oscillator sweeps ±1.5 megacycles around the center frequency.

Since the voltage versus capacitance characteristic of CR7 is nonlinear, a voltage compensation network is added. This network provides a linear relationship of frequency as a function of time for the sawtooth wave from the horizontal amplifier. The voltage compensation network, or linearity shaping network, consists of four diodes, CR3 through CR6, and associated resistive loads for each diode. Since each load differs, each diode clamps at a different voltage level; hence, the linear voltage versus time characteristic of the sawtooth wave is reshaped to compensate for the nonlinear voltage versus capacitance characteristic of CR7. Thus, a linear frequency versus time characteristic at the output of the sweep oscillator is achieved, and this output is fed to the first mixer input, Q1, through C34.

The sawtooth generator Q9, Q10, and Q11 develops a sawtooth wave for application to the sweeping local oscillator and to the horizontal deflection plates of the CRT. The first stage, Q9, is a common emitter dc amplifier whose output is simultaneously coupled to the emitter of the unijunction transistor, Q10, the base of Q11, and a capacitance network. Initially, the output of Q9 gradually builds up to the voltage level across the capacitance network C42, C43, C44, and C45. The "rate" of this voltage build-up is determined by the setting of the sweep rate control, R40. As the voltage across the capacitance network reaches the required level, the unijunction transistor, Q10, conducts through its emitter circuit

and quickly discharges the voltage across the capacitance network. Since the time required for discharging the capacitors is much shorter than the time required for charging, the resultant waveform produced across the capacitors is a sawtooth. Normally, the rate of charging and discharging these capacitors is set for 15 cps by adjustment of R40.

Q11, an emitter follower, receives the sawtooth signal and isolates the input from the output. A portion of Q11 output is fed back to C43 and C45 through the linearity control, R42. This forms a bootstrap circuit permitting the linearity of the resulting sawtooth waveform to be adjusted by variation of R42. Also, it should be noted that B1 of Q10 is connected to the base of Q9. This negative feedback loop helps to improve the linearity of the sawtooth wave.

The horizontal deflection amplifier is used to amplify the output of the sweep generator for application to the CRT as a horizontal deflection voltage and for application to the sweep oscillator, through SWEEP WIDTH and MAX SWEEP controls, to produce a sweeping local oscillator synchronized with the horizontal sweep of the CRT.

The output of the sawtooth generator is fed directly to the base of Q12 through the HORIZ GAIN control, R46. Q12 is a phase splitter which provides an output at the collector opposite in phase with respect to the emitter. The collector output of Q12 is RC coupled to Q14, and the emitter output of Q12 is RC coupled to Q13. Therefore, the outputs of Q13 and Q14 are opposite in phase and approximately equal in amplitude

(about 75 volts peak to peak), since R47 and R48 are equal in value. In other words, Q12, Q13, and Q14 form a push-pull amplifier which drive the horizontal deflection plates of the CRT. However the output of Q13 is also coupled to the sweep oscillator as mentioned in the preceding paragraph. Potentiometer R21 is provided for horizontal position adjustment by varying the dc potential on one of the horizontal plates.

The first mixer consists of transistors Q1 and Q2 on the IFS-101 board which are connected in cascode. These two transistors are dc coupled, the bias being determined by the value of resistors R1 and R2 in the base of Q1 and the emitter resistor, R3, of Q1. Transistor Q1 is operated in a common emitter configuration while transistor Q2 is operated in a common base configuration. The mixer has three inputs: signal and markers from the marker generator, the output from the input amplifier board across C14, and the output from the sweeping local oscillator which is applied to the base of Q1 through coupling capacitor C34. Mixing is accomplished in the emitter-base junction of Q1, the resulting products are amplified by Q2 and applied to the 4.3 megacycle tank circuit consisting of L1, L2 and associated circuits. The primary of the tank circuit consists of L1 and C3 which is coupled to the secondary of the tank by coupling capacitor C5. The secondary consists of L2 and the resonating capacitors C6 and C7. C6 and C7 also provide impedance matching to the following amplifier circuit. This tank circuit resonates at 4.3 megacycles and rejects the 21.4 and 27.5 megacycle signals present at the input of the

mixer. The bandwidth of the 4.3 megacycle tank circuit is approximately 100 kilocycles.

The 4.3 megacycle IF amplifier consists of Q3 and Q4 connected in a cascode configuration. Q3 is forward gain controlled. Since Q3 is an n-p-n transistor, the gain control voltage is positive. The output of the 4.3 megacycle cascode amplifier, Q1 and Q2, is coupled to the second mixer input via a double-tuned filter consisting of L3, L4, and associated components which are identical to those existing between the first mixer and the 4.3 megacycle IF amplifier.

Q5, an SP8675 transistor, is the second mixer, converting from 4.3 megacycles to 455 kilocycles. The mixer has two inputs. One input is from the second local oscillator Q6 which operates at 4.755 megacycles. The other input is from the 4.3 megacycle signal developed across C15. Both of these signals are applied to the base of Q5 which operates as a common emitter mixer-amplifier. Mixing is accomplished in the emitter-base junction of Q4 with both the emitter and the collector circuits resonated at 455 kilocycles by crystal filter Y2. Thus, Q5 is highly degenerative at frequencies other than 455 kilocycles. In the collector circuit of Q5, inductor L5 is parallel resonated at 455 kilocycles with capacitors C18 and C23. The bandwidth of Y2 is very narrow and the resulting overall bandwidth of the entire 455 kilocycle amplifier is extremely narrow permitting the 3 db resolution of the signal display unit to be approximately 10 kilocycles. The output of the second mixer is applied to the first 455 kilocycle

amplifier across C23.

The 455 kilocycle center frequency signal from the second mixer is coupled to the 455 kilocycle IF amplifier, Q7, via a single tuned filter composed of L5, C18, and C23. The filter output voltage is stepped down through the voltage divider, C18 and C23, in order to match the low input impedance of Q7. The output circuit of Q7 is again a single tuned circuit, T1. The output voltage is stepped up through T1 before being RC coupled to the push-pull detector.

The push-pull detector rectifies the 455 kilocycle IF signal, obtaining a dc voltage which varies according to the IF signal amplitude. The detector applies this voltage directly to the vertical deflection plates of the CRT, with the result that the vertical height of the signal trace varies directly with the input signal amplitude, subject, however, to the GAIN control setting.

The circuit is effectively two series diode detectors. CR1 and CR2 with opposite polarities having their outputs filtered through two identical RC networks.

The CRT has a rectangular face measuring 2-3/4 by 1-1/4 inches overlaid with green Plexiglass. The Plexiglass is inscribed with a horizontal base line, and a vertical center line. The markers are for relative reference only and are not calibrated to read in specific units.

The CRT uses a minus 1200 volts dc accelerating potential. From the power supply, this source is connected across a voltage divider

to ground. This network includes potentiometers R23 and R25, and resistors R24, R26, and R27. R23 functions as the INT control by controlling the voltage to the control grid. R25 functions as the FOCUS control by controlling the voltage to the first anode. Fixed astigmatism control is derieved by the connection of the second anode to the junction of resistors R20 and R21. Horizontal and vertical positioning of the trace is obtained by adjusting potentiometers R21 and R18, respectively.

The power supply contained in the signal display unit furnishes all the power requirements for the CRT. ±12 volt dc power supplies for the transistors are derived from the receiver power supplies.

The power transformer, T1, has an electrostatic shield between the primary and secondary sides. It has three secondary windings. One of these is a 6.3 volt winding used for the filament of the CRT. Another secondary winding, pins 7 and 8, is connected to a full wave bridge rectifier, CR4, the output of which is passed through a conventional condenser input filter before being coupled to the +150 volt dc Zener diode voltage regulator, CR5. The third winding, pins 5 and 6, powers a full wave voltage doubler circuit producing -1200 volts dc at the output. VR1 is a corona regulator diode used to regulate the output voltage at -1200 volts dc.

SECTION V

MAINTENANCE

1. General Information.

The SR-212 receiving system is a completely transistorized high performance receiver with the exception of the cathode ray tube used in the spectrum display portion of the equipment. Prior to its shipment from the factory, the equipment was completely inspected, aligned, and tested to a rigid set of specifications. Consequently, there should be few, if any, reasons to perform repairs to the equipment. In the event, however, that a malfunction occurs, it is first necessary to isolate the source of the difficulty to a particular portion of the receiver circuitry. The first step in determining the location and cause of a malfunction in the system is to check the condition of all connectors and cables used in delivering signals to, or outputs from, the receiver. Make certain that the correct antenna inputs are connected. The correct loads must be connected to the various outputs from the receiver.

Maintenance personnel should be thoroughly familiar with the Theory of Operation presented in a previous section of this manual. The trouble-shooting chart presented in this section of the maintenance manual will be found to be of great value in determining the initial procedures for the localization of defective circuits or components. However, no information presented in this section of the manual will replace a thorough grounding

in the theory of transistor circuits and a knowledge of the method by which the receiver generates the desired output characteristics.

> WARNING
>
> High voltages are used in the beam forming and accelerating processes of the SDU cathode ray tube. Do not perform any maintenance operations without first determining that these potentials have been discharged.

In general, considering the modular construction techniques used in the receiver, troubleshooting techniques are slightly different from those formerly used with conventional receivers. Generally, it is more practical to isolate the difficulty to a particular module of the receiver than to a particular component. Therefore, when the difficulty has been isolated to a module, the module should be replaced and the receiving system replaced in service. After this has been done, the repair of the defective module may be accomplished in either one of two ways. Either the module may be returned to the factory repair facility, or the user may elect to repair the defective module himself. The manufacturer of the model SR-212 receiver does not recommend repairs upon the various replaceable tuning units in the receiver by field maintenance personnel. In most cases, the original performance of the module cannot be restored without the facilities of the factory. Minor parts replacement can be attempted upon the IF sections of the receiver without factory facilities, but it is unlikely that the necessary

trained personnel will be available for tuner repairs. Therefore, defective tuners and associated gear trains should be returned to the factory for repair.

2. Special Test Equipment Considerations.

The use of solid state components in the design of the SR-212 receiving system results in circuitry which requires special consideration in the areas of test equipment application. Damage to transistors is usually the result of the application of excessive current or voltage to the transistor junctions. Such excessive voltages or currents may result from the application of voltages from an external source, as in the case of the use of an ohmmeter, or may be the result of a change in the transistor bias conditions caused by loading from a low impedance meter or other instrument.

Some of the most common conditions which may result in the application of excessive voltages or currents to the junction of the transistors used in the receiver are discussed below:

A. Test Probes: The test probes used in measurements upon transistor circuits should be clean and sharp. Dull or blunted probes may slip off of the circuit of interest and inadvertently short circuit a sensitive area causing damage to components. In addition, the resistors and other components used in transistorized circuits are often of very low absolute resistance. Additional resistance caused by dull or dirty test probes may well cause the component to appear out of tolerance when measured. Further, many of the leads and terminals are coated with an insulating varnish or bonding material and a sharp pointed test probe is needed to pierce this

material. In miniaturized transistor circuitry, the clearance between components and associated wiring is often quite small and as a result the test probes used should normally be covered with insulating tape or sleeving.

B. Low-Sensitivity Multimeters: Another common cause of damage to transistors during the troubleshooting operation is the use of the multimeters or ohmmeters that have low sensitivity. Such meters require excessive drive from the circuit under evaluation in order to achieve reasonable meter movement. The result of the use of such instruments is that bias circuits are often disturbed with resulting high currents or voltages in the affected transistor circuitry. In view of these considerations, a multimeter that has a sensitivity of less than 5,000 ohms per volt should not be used. The meters and other test equipment recommended in this procedure comply with this requirement. If a substitution must be made, the use of a 20,000 ohm per volt meter or a vacuum tube voltmeter is recommended. As an added precaution, check the proposed replacement meter with a milliammeter. If the indication of the milliammeter is in excess of about one milliampere, it is possible that damage to the transistors may result from its use.

C. Transformerless Power Supplies: Test equipment which does not have an input isolating power transformer may also be a source of excessive current. Damage may result to delicate components in the receiving system if a line isolating transformer is not used.

WARNING

If an isolation transformer is connected in the power line, do not touch the chassis of the test equipment. The isolation transformer permits the chassis of the test equipment to assume a potential above that of ground.

D. Line Filters: Delicate components may be damaged by the application of excessive currents or voltages even if an isolation transformer is used in all associated test equipment, if a line filter has been installed between the power line main and the input of the receiver. This condition arises as a result of the fact that certain types of line filters may act as a voltage divider resulting in the application of 55 vac to the chassis of the unit. This situation may readily be eliminated by connecting a ground lead between the receiver and the associated test equipment before connecting any test equipment.

3. Transistor Test Procedures.

A. Replacement of Transistors in Operating Circuits: Never remove or replace a transistor when the equipment is energized because transients thus produced would probably damage the transistor or cause damage to other transistors remaining in the circuit. When servicing transistors of the plug-in type, it is good practice to remove the transistor from its socket and then reinsert it to break down any film of corrosion or dirt that may have formed.

B. Resistance Measurements in Transistor Circuits: When making

resistance measurements in transistor circuits or circuits employing semiconductor diodes, the proper polarity and ohmmeter range should be ascertained before any measurements are performed. Any capacitors used in transistor circuits, especially those in audio or power circuits, are usually of large values and a longer charge time is required when an ohmmeter is connected in the circuit. Therefore, any indication of the value of the capacitor is subjected to error if the capacitor has not been allowed time to charge. In some instances, it may be best to isolate the components in question and measure them individually.

C. Testing Transistors with an Ohmmeter: If a transistor tester is not readily available, an ohmmeter may be used to check transistors. To check a p-n-p transistor, connect the positive lead of the ohmmeter to the base and the negative lead to the emitter. Generally, a resistance reading of 50,000 ohms or more should be obtained. Connect the negative lead to the collector; again a reading of 50,000 ohms or more should be obtained. Connect the negative lead of the ohmmeter to the base. With the positive lead connected to the emitter, a resistance value of 500 ohms or less should be obtained. In like manner, with the positive lead connected to the collector, a value of 500 ohms or less should be obtained. Similar tests on an n-p-n transistor should produce the following results: with the negative ohmmeter lead connected to the base, the value of resistance between the base and emitter and between base and collector should be high. With the positive lead of the ohmmeter connected to the base, the value of resistance

between the base and collector should be low. If the resistance values between the base, collector and emitter of the transistor are not as indicated, the component is defective and should be replaced.

> WARNING
>
> When a defective transistor is found, make certain before inserting the replacement transistor, that the circuit is in good operating order. An existing short circuit would most likely result in another burned out transistor as soon as the equipment was energized. Do not depend on fuses for transistor protection.

Make sure that the values of the bias resistors in series with the various transistor elements are as shown on the schematic diagrams. The transistor is sensitive to improper bias voltages; therefore, a short or open circuit in the bias resistor may damage the transistor. For this reason, do not troubleshoot a transistorized receiver by shorting various points in the circuit to ground.

4. Module Repair.

The miniature construction techniques of the receiver, such as the printed circuit boards, present the need for special repair practices.

A. Tools: Special tools are required for repairing the modules. These include a light-duty pencil type soldering iron, a pair of small long-nosed pliers, a small wire cutter, a soldering aid tool, and miscellaneous screw drivers and Bristol wrenches. The soldering aid should have a notch on one end for gripping wires, while the other end should have a

fine point for cleaning away solder from small openings. In addition to these tools, a small knife and a small wire brush are useful for cleaning solder and bonding compound from the printed circuit boards.

B. Soldering: In all probability, the prime cause of repair difficulty can be traced to improper use of the soldering iron or the soldering iron itself. Heavy duty soldering irons can not successfully be used for printed circuit board repair. Light-duty soldering irons of 20 to 25 watts capacity are adequate for module repair. The soldering iron should be equipped with a small tip so that heat can be applied to printed circuit board terminals without overheating adjacent parts. Proper selection of solder is also an important consideration when repairing printed circuit boards. The solder used should have small diameter, a rosin core and a tin to lead ratio of 60/40. Large-diameter solder with a high lead content will result in damage to the printed circuit board because of the higher value of heat required for solder flow. When removing or installing components on printed boards, do not overheat the printed board. This will cause the printed conductors to separate from the board and cause printed board terminals to loosen. Tin the leads of the component circuit terminals to assure a good solder joint without overheating the printed circuit board terminal or the component part. Preforming of the component leads will avoid excessive strain on the printed circuit board terminals. When soldering transistors, grasp the transistor lead between the transistor and the solder joint with a pair of long nose pliers. The jaws of the pliers

will act as a heat sink to carry away the heat while the solder on the joint is being melted by the iron. Keep the pliers on the lead for a short time after the soldering iron is removed to make certain all heat has been dissipated.

C. Printed Circuit Board Component Replacement: Malfunctioning resistors, capacitors and inductors which are soldered to the printed circuit board can be replaced using the following procedure:

(1) Cut the leads where they enter the defective component.

(2) If the malfunctioning component is bonded to the printed circuit board, soften the bonding compound with a soldering iron and remove the component. Remove excess bonding compound and foreign material.

(3) Remove clipped leads from printed circuit board terminals by applying a soldering iron to the printed wiring side of the board. Avoid overheating the printed circuit board.

(4) Clean all moisture, grease and wax from the printed circuit board with a solvent.

(5) When replacing the new component, preform the leads to avoid excessive strain on the printed circuit board terminals. Tin the leads of the terminal to assure a good solder joint without overheating the board. After soldering the lead to the printed circuit terminal, cut off excess lead length close to the solder joint.

(6) If the original part was bonded to the printed circuit board, rebond the new component to the board using a good bonding agent.

5. Test Equipment Required.

Table 5-1. Required Test Equipment Characteristics.

EQUIPMENT	MODEL	MFG	REQUIRED CHARACTERISTICS
Sweep Generator	HD-1A	Telonic	Sweep Rate: 0.01 to 100 cps RF Attenuation: 0 to 60 db in 1 db steps Mkr System: Birdy-by-pass, Ext. marker in, Plug-in cyrstal markers, rectified markers Output Impedance: 50 ohms Scope Horizontal Output: 15 volts p-to-p
Signal Generator	606A	Hewlett-Packard	Freq. Range: 50 kc to 65 mc in six bands RF Output: 0.1 microvolt to 3 volts Modulation: AM, 0 to 100%, 400 and 1000 cps; external 0 to 100%, dc to 20 kc Output Impedance: 50 ohms
Signal Generator	608D	Hewlett-Packard	Freq. Bands: 20 to 420 mc in five bands RF Output: 0.1 microvolt to 0.5 volts Modulation: 0 to 95%, 400 to 1000 cps; external CW, 0 to 95%, 20 cps to 20 kc; external pulse, 40 to 420 mc Output Impedance: 50 ohms

Table 5-1. Required Test Equipment Characteristics. (Cont)

EQUIPMENT	MODEL	MFG	REQUIRED CHARACTERISTICS
Oscilloscope	503	Tektronix	Freq. Range: DC to 450 kc Vertical Sensitivity: 1 mv/cm to 20 volt/cm Sweep Range: 1 microsecond/cm to 5 sec/cm Input Impedance: 1 meg ohm shunted by 47 pf
VTVM	WV-98C	RCA	Range: 0 to 1500 volts, ac and dc, 0 to 1000 meg ohms Input Resistance: 11 meg ohms, dc Freq Range: 30 cps to 3 mc Accuracy: ±3%
VTVM	400H	Hewlett-Packard	Range: 1.0 millivolt to 300 volts ac Input Impedance: 10 meg ohms shunted by 15 pf Freq. Range: 10 cps to 4 mc Accuracy: ±1% 50 cps to 500 kc, ±2% 20 cps to 1 mc, ±3% 20 cps to 2 mc, ±5% 10 cps to 4 mc
Detector	XD-4A	Telonic	Freq. Range: 0.1 to 300 mc Input Impedance: 50 ohms Type of Detection: Half-wave

Table 5-1. Required Test Equipment Characteristics. (Cont)

EQUIPMENT	MODEL	MFG	REQUIRED CHARACTERISTICS
Signal Generator	612A	Hewlett-Packard	Freq. Range: 450 to 1230 mc RF Output: 0.1 microvolt to 0.5 volts Modulation: AM, 0 to 90%, 400 and 1000 cps;external, 20 cps to 5 mc, above 470 mc, 2 volt rms produces 85% AM at frequencies up to 1 mc; at least 40% at 5 mc Output Impedance: 50 ohms
Signal Generator	202H	Boonton	Freq. Range: 54 to 216 mc in two bands RF Output: 0.1 microvolt to 0.2 volts Modulation: Internal 0 to 50%, external 0 to 100% FM deviation, 0 to 250 kc in four ranges; pulse 0.25 microsecond rise time, 0.8 microsecond decay time Output Impedance: 50 ohms
Univerter	207H	Boonton	Freq. Range: 100 kc to 55 mc RF Output: 1 microvolt to 1 millivolt and greater than 1 volt Output Impedance: 50 and 300 ohms

Table 5-1. Required Test Equipment Characteristics. (Cont)

EQUIPMENT	MODEL	MFG	REQUIRED CHARACTERISTICS
Audio Generator	200CD	Hewlett-Packard	Freq. Range: 5 cps to 600 kc in five ranges Output: 10 volts 600 ohm load, 20 volts open circuit
Noise Figure Meter	340B	Hewlett-Packard	Freq. Range: ,30 or 60 mc Noise Figure Range: 0 to 15 db to infinity Accuracy: ±1 db overall Bandwidth: 1 mc nominal Impedance: 50 ohms
VHF Noise Source	343A	Hewlett-Packard	Noise Output: 10 to 600 mc Impedance: 50 ohms
UHF Noise Source	349A	Hewlett-Packard	Noise Output: 400 to 4000 mc Excess Noise: 15.2 ±0.5 db

6. Tuning Tapes and Gear Drives.

When the maintenance procedure requires parts replacement in the gear train, inductuners or preselector of the RF tuners, it will be necessary to perform certain mechanical adjustments to the gear train. The adjustment procedure outlined below is adequate to initially align the frequency indicating tape dial with the inductuner or preselector. The alignment is performed as follows:

A. Loosen the two set screws which hold the large gear to the shaft of the inductuner or preselector. Make certain that the large gear remains engaged in the teeth of the small drive gear or the antibacklash springs within the large gear may be lost.

B. Rotate the inductuner (clockwise) to the extreme high frequency position, or rotate the preselector (counter-clockwise) to the extreme low frequency end.

C. Rotate the gear train associated with the preselector to the mark on the extreme low frequency end of the frequency indicating tape dial, or rotate the gear train associated with the inductuner to the mark on the extreme high frequency end of the frequency indicating tape dial.

D. Check to make certain that the large gear is completely engaged in its associated small drive gear.

E. Tighten the two set screws which hold the large gear to the shaft of the inductuner or preselector.

F. Rotate the gear train over the entire tuning range of the receiver

to ascertain that there is no backlash and no sign of binding.

7. ±12 Volt and 24 Volt DC Power Supplies, PS-211.

A. Table 5-2 is a tabulation of the dc voltages on the transistors of a normally operating PS-211 power supply. Measurements were made with an RCA Senior Voltohmyst Model WV-98C and are referenced to ground. Controls on the front panel of the receiver were positioned as follows:

TUNING RANGE MC	30-100
Tuning Control	30 mc
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR-ON	ON
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY and GAIN controls should be adjusted for the normal presentation on the signal display unit.

Transistor Symbol Number	Emitter	Base	Collector
+12 Volt Supply			
Q1	0.78	1.3	8.4
Q2	-5.6	-5.0	0.13
-12 Volt Supply			
Q3	-24.5	25	34
Q4	-12.6	13.2	20
24 Volt Supply			
Q5	6.2	7.0	13.2

Table 5-2. PS-211 Transistor Voltages.

B. Power Supply Adjustment: The output of the 12 volt power supply is measured at pin B16 on the power supply connector. The output of the minus 12 volt power supply is measured at pin A5 of the power supply connector. An RCA Model WV-98C Senior Voltohmyst or equivalent should be used to measure these voltages. If the voltage measurements vary more than ±0.5 volts from the required amounts, resistor R5 should be varied for the minus 12 volt power supply and resistor R14 should be varied for the 12 volt power supply to return the voltages to normal.

The output of the 24 volt power supply is measured at pin A14 of the power supply connector. In the event that this voltage, when measured with an RCA Model WV-98C Voltohmyst or equivalent, varies in a large amount from that required, the 24 volt portion of the power supply card should be replaced or repaired.

8. 3 Mc Bandwidth IF Amplifier.

A. Normal Operating Voltages: Table 5-3 is a tabulation of the dc voltages measured on the transistor elements of a normally operating 3 mc bandwidth IF amplifier. Measurements were made with an RCA Senior Voltohmyst Model WV-98C and are referenced to ground, controls on the front panel of the receiver were positioned as follows:

TUNING RANGE MC	30-100
Tuning Control	30 mc
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range

MKR-ON	ON
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for the normal presentation on the signal display unit.

Transistor Symbol Number	Emitter	Base	Collector
Q1	-1.9	-1.3	6.6
Q2	-0.6	GND	10
Q3	-1.1	-0.4	7.3
Q4	-0.64	GND	10
Q5	-8.7	-8	-0.64
Q6	-0.64	GND	11.4
Q7	0.08	0.72	12
Q8	-0.72	-0.12	12
Q9	-9.4	-8.8	-0.5
Q10	-0.5	GND	6.8
Q11	1.7	1.65	7.6
Q12	-1.7	-1.0	12
Q13	-3.2	-2.5	12

Table 5-3. 3 Mc Bandwidth IF Amplifier Transistor Voltages.

B. Alignment of 3 Mc Bandwidth IF Amplifier Module, IF-221-3000: To align the amplifier, disconnect the Microdot connector at the input to the IF amplifier at J2. A Microdot to BNC connector should then be connected to this jack, and the test equipment connected as shown in Figure 5-1. It is suggested that the actual alignment be performed with the sweep generator connected to E1 and then checked with the sweep generator connected to J4. Since J4 is ac coupled, a shift in dc reference level may be observed.

Controls on the front panel of the receiver should be positioned as follows:

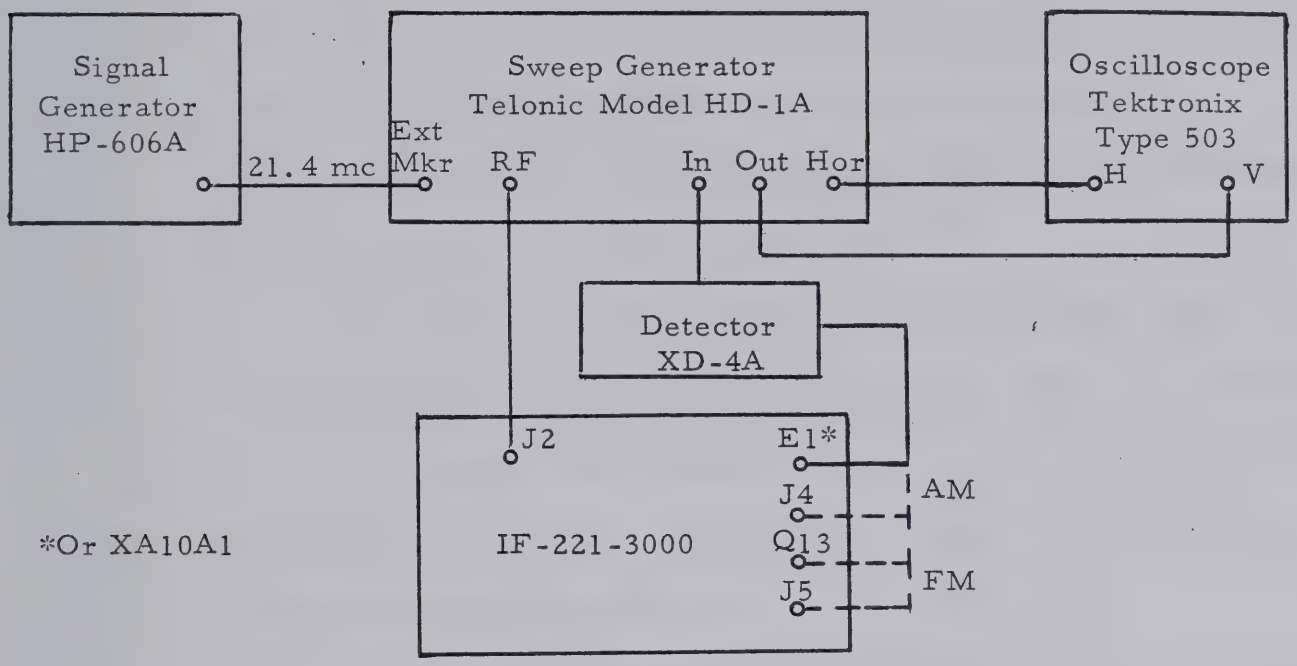


Figure 5-1. Test Configuration for IF-221-3000 Amplifier Alignment.

TUNING RANGE MC	30-100
Tuning Control	Mid-range
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR-ON	ON
BFO TUNING	Mid-range
FINE TUNING	Mid-range

Alignment of the 3 mc IF amplifier may be performed by the following procedure.

(1) Adjust Signal Generator HP-606A for a frequency output of 21.4 mcs. A frequency counter, the zero beat technique, or another accurate method should be used to obtain this frequency.

(2) Adjust Sweep Generator Telonic HD-1A for a frequency output of 21.4 mcs.

(3) Adjust the horizontal gain of Oscilloscope Tektronix 503 as required for full scale deflection of the horizontal sweep.

(4) Adjust the vertical amplifier of Oscilloscope Tketronix 503 for a 0.5 volts per centimeter of deflection.

(5) Adjust the output of Sweep Generator Telonic HD-1A to provide an IF response of 2 volts p-to-p, as indicated on Oscilloscope Tektronix 503.

(6) Adjust signal generator output control and sweep generator marker control to provide a small 21.4 mc marker on the IF response curve displayed on the oscilloscope.

(7) Adjust inductances L1 through L6 for a maximum symmetrical response curve centered around the 21.4 mc marker, as illustrated in Figure 5-2. Reduce the output of the sweep generator as required to maintain a constant amplitude of the response curve displayed on the oscilloscope.

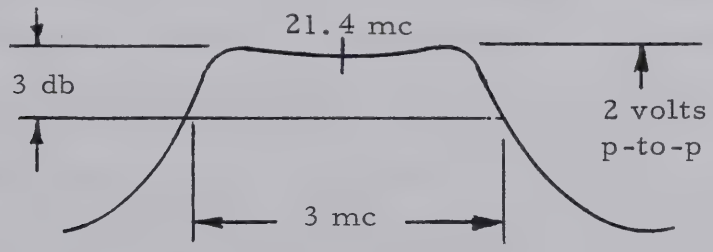


Figure 5-2. Typical 3 Mc IF Amplifier Response.

C. FM Alignment: After the AM alignment has been completed, the FM alignment may be performed. To perform the alignment proceed as follows:

(1) With the equipment connected as shown in Figure 5-1, remove the cable from terminal E1 on the IF chassis and connect it to the emitter of transistor Q12.

(2) Adjust the output levels of the test equipment to those specified in steps (1) through (5) of the 3 mc AM alignment procedure.

(3) The resulting discriminator response as observed on the oscilloscope should have a peak-to-peak amplitude of from 2 to 4 volts.

(4) Adjust L8, L9, and L11 for a maximum symmetrical response centered around the 21.4 mc marker. Exercise extreme care to assure that the center portion of the S curve is as linear as possible. The peak-to-peak separation should be approximately 3.3 mcs.

> CAUTION
>
> The adjustment of coupling loop L10 is quite critical. This loop has been carefully adjusted at the manufacturers facility and should not be tampered with in the field.

(5) Remove the cable from the emitter of transistor Q12 and connect it to the 3 MC IF FM VIDEO out jack J5. Check the S curve obtained in step (4) above. The S curve should be similar except for a change in dc reference level. A typical S curve is shown in Figure 5-3.

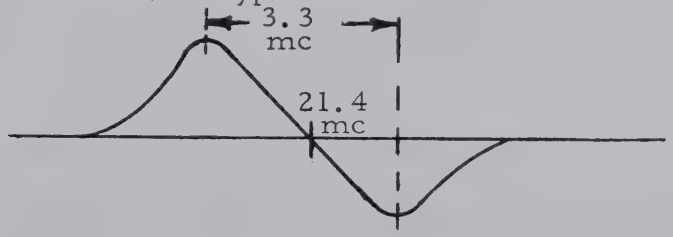


Figure 5-3. Typical 3 Mc IF Amplifier FM Response.

9. 20 Kc IF Amplifier, IF-210-20.

A. Normal Operating Voltages: Table 5-4 is a list of the dc voltages normally encountered on the elements of transistors in the 20 kc IF amplifier. Measurements were made with an RCA Senior Voltohmyst Model WV-98C. Throughout the measurements, the front panel controls were in the following positions:

IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR-ON	ON
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for the normal presentation on the signal display unit.

Transistor Symbol Number	Emitter	Base	Collector
Q1	6.18	6.18	9.6
Q2	-5.9	-5.2	-0.64
Q3	-0.64	GND	9.6
Q4	-5.6	-5.3	-0.8
Q5	-0.8	GND	9.8
Q6*	5.2	5.1	11.4
Q7	-0.78	-0.16	10
Q8	-2.8	-2.1	-0.78
Q9	-0.78	GND	3.4
Q10	-1.0	-0.4	11

*Q6 measured with function switch in CW position.

Table 5-4. 20 Kc Bandwidth IF Amplifier Transistor Voltages.

B. AM Alignment of the 20 Kc Bandwidth IF Amplifier:

(1) Connect the test equipment to the receiver in the manner illustrated in Figure 5-4. Energize the test equipment and allow a warm-up time as indicated by the test equipment manufacturer's specifications.

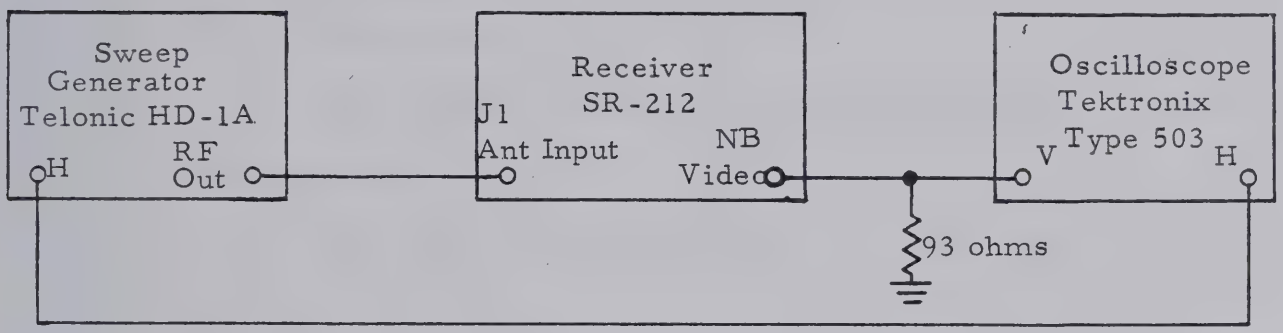


Figure 5-4. 20 Kc IF Bandwidth Amplifier Alignment Test Setup.

(2) Position the controls on the front panel of Receiver SR-212 as follows:

TUNING RANGE MC	30-100
Tuning Control	65 mc
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for the normal presentation on the signal display unit.

(3) Remove the IF-210-20 printed circuit card from its receptacle. Remove the nylon key from the receptacle. Insert a card extender into the IF-210-20 receptacle. Insert the IF-210-20 printed circuit card into the card extender.

(4) Energize Receiver SR-212 by placing the POWER switch in the ON position.

(5) Adjust Sweep Generator Telonic HD-1A for a frequency output of 65 mcs.

(6) Adjust the horizontal gain of Oscilloscope Tektronix 503 as required for full scale deflection of the horizontal sweep.

(7) Adjust the vertical amplifier of Oscilloscope Tektronix 503 for a 0.5 volts per centimeter of deflection.

(8) Adjust the output of Sweep Generator HD-1A and Receiver SR-212 RF GAIN control to provide an IF response of 4 centimeters as observed on Oscilloscope Tektronix 503.

(9) Turn the FM-AM/AGC-AM/MAN-CW selector switch to the CW position. A 21.4 mc marker will now be observed on Oscilloscope Tektronix 503.

(10) Turn FM-AM/AGC-AM/MAN-CW selector switch to AM/MAN and adjust Receiver SR-212 tuning control so that the IF response

is centered around the 21.4 mc marker.

(11) Adjust L1 and L2 for maximum amplitude. Adjust L5, L6, C13, and C15 for maximum symmetrical response.

(12) Alternately switch the FM-AM/AGC-AM/MAN-CW selector switch from CW to AM/MAN to assure that the response is centered around the 21.4 mc marker. A typical response is shown in Figure 5-5.

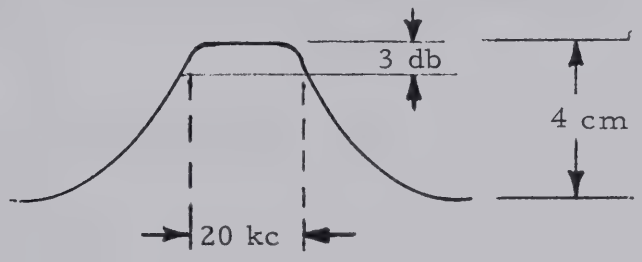


Figure 5-5. 20 Kc IF Amplifier AM Response.

C. FM Alignment of the 20 Kc Bandwidth IF Amplifier:

General: The FM discriminator response curve is dependent on the AM circuit alingment; therefore, it is necessary for the AM alignment to be performed first. In practice, an incorrect discriminator response curve can sometimes be traced to malaligned AM circuits. To align the FM circuits of the 20 kc bandwidth IF amplifier proceed as follows:

(1) Connect the test equipment to the receiver as shown in Figure 5-3.

(2) Position the controls on the front panel of Receiver SR-212 as follows:

TUNING RANGE MC	30-100

Tuning Control	65 mc
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	FM
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for the normal presentation on the signal display unit.

(3) Repeat steps (3) through (8) of the AM circuit alignment as required to provide an S curve response on the oscilloscope of 4 centimeters peak-to-peak deflection.

(4) Turn the FM-AM/AGC-AM/MAN-CW selector switch to CW. A 21.4 mc marker will now be observed on Oscilloscope Tektronix 503.

(5) Turn the FM-AM/AGC-AM/MAN-CW selector switch to FM and adjust Receiver SR-212 tuning control so that the discriminator response curve is centered around the 21.4 mc marker.

(6) Adjust L8 for maximum amplitude and L9 and L10 for maximum linearity of response. When L10 is adjusted correctly, the 21.4 mc crossover point will occur at the center of the response curve as indicated on Oscilloscope Tektronix 503.

(7) Alternately switch the FM-AM/AGC-AM/MAN-CW selector switch from FM to CW to assure that the response is centered around the 21.4 mc marker. A typical response is shown in Figure 5-6.

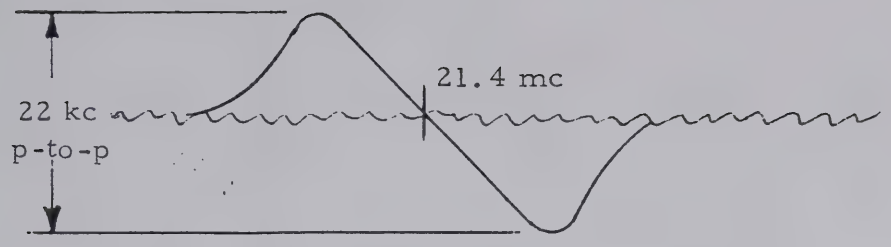


Figure 5-6. 20 Kc IF Amplifier FM Response.

10. 75 Kc Bandwidth IF Amplifier, IF-211-75.

A. Normal Operating Voltages: Table 5-5 is a tabulation of the dc voltages normally encountered on the elements of transistors in the 75 kc IF amplifier. Measurements were made with an RCA SeniorVoltohmyst Model WV-98C. Throughout the measurements, the front panel controls were in the following positions:

IF BANDWIDTH KC	75
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Full CW
AUDIO GAIN	Mid-range
VIDEO GAIN	Mid-range
MKR-ON	ON
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for the normal presentation on the signal display unit.

Transistor Symbol Number	Emitter	Base	Collector
Q1	5.8	5.8	9.7
Q2	-5.8	-5.2	-0.61
Q3	-0.61	GND	9.7
Q4	-5.8	-5.2	-0.64
Q5	-0.64	GND	9.8
Q6	6.4	5.1	11.4*
Q7	-0.77	-0.15	10.1
Q8	-2.6	-2.0	-0.68
Q9	-0.68	GND	4.2
Q10	-1.0	-0.4	11.2

*Q6 measured with function switch in CW position.

Table 5-5. IF-211-75 Transistor Voltages.

B. Alignment of the 75 Kc Bandwidth IF Amplifier:

(1) Connect the test equipment to the receiver in the manner illustrated in Figure 5-3. Energize the test equipment and allow a warm-up time as indicated by the test equipment manufacturer's specifications.

(2) Position the controls on the front panel of Receiver SR-212 as follows:

TUNING RANGE MC	30-100
Tuning Control	65 mc
IF BANDWIDTH KC	75
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for the normal presentation of the signal

display unit.

(3) Remove the IF-211-75 printed circuit card from its receptacle. Remove the nylon key from the receptacle. Insert a card extender into the IF-211-75 receptacle. Insert the IF-211-75 printed circuit card into the card extender.

(4) Energize Receiver SR-212 by placing the POWER switch in the ON position.

(5) Adjust Sweep Generator Telonic HD-1A for a frequency output of 65 mcs.

(6) Adjust the horizontal gain of Oscilloscope Tektronix 503 as required for full scale deflection of the horizontal sweep.

(7) Adjust the vertical amplifier of Oscilloscope Tektronix 503 for a 0.5 volts per centimeter of deflection.

(8) Adjust the output of Sweep Generator Telonic HD-1A and Receiver SR-212 RF GAIN control to provide an IF response of 4 centimeters as observed on Oscilloscope Tektronix 503.

(9) Turn the FM-AM/AGC-AM/MAN-CW selector switch to the CW position. A 21.4 mc marker will now be observed on Oscilloscope Tektronix 503.

(10) Turn FM-AM/AGC-AM/MAN-CW selector switch to AM/MAN and adjust Receiver SR-212 tuning control so that the IF response is centered around the 21.4 mc marker.

(11) Adjust L1 through L6 for maximum symmetrical response

centered around the 21.4 mc marker.

(12) Alternately switch the FM-AM/AGC-AM/MAN-CW selector switch from CW to AM/MAN to assure that the response is centered around the 21.4 mc marker. A typical response is shown in Figure 5-7.

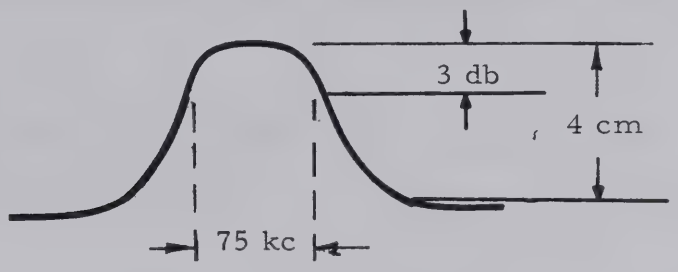


Figure 5-7. 75 Kc IF Amplifier AM Response.

C. FM Alignment of the 75 Kc Bandwidth IF Amplifier:

(1) Connect the test equipment to the receiver as shown in Figure 5-3.

(2) Position the controls on the front panel of Receiver SR-212 as follows:

TUNING RANGE MC	30-100
Tuning Control	65 mc
IF BANDWIDTH KC	75
FM-AM/AGC-AM/MAN-CW	FM
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for the normal presentation on the signal display unit.

(3) Repeat steps (3) through (8) of the AM circuit alignment as required to provide an S curve response on the oscilloscope of 4 centimeters peak-to-peak deflection.

(4) Turn the FM-AM/AGC-AM/MAN-CW selector switch to CW. A 21.4 mc marker will now be observed on Oscilloscope Tektronix 503.

(5) Turn the FM-AM/AGC-AM/MAN-CW selector switch to FM and adjust Receiver SR-212 tuning control so that the discriminator response curve is centered around the 21.4 mc marker.

(6) Adjust L8 for maximum amplitude and L9 and L10 for maximim linearity of response. When L10 is adjusted correctly, the 21.4 mc crossover as indicated on Oscilloscope Tektronix 503 will occur at the center of the response curve.

(7) Alternately switch the FM-AM/AGC-AM/MAN-CW selector switch from FM to CW to assure that the response is centered around the 21.4 mc marker. A typical response is shown in Figure 5-8.

(8) Deenergize Receiver SR-212 and replace printed circuit card IF-211-75 in its respective receptacle.

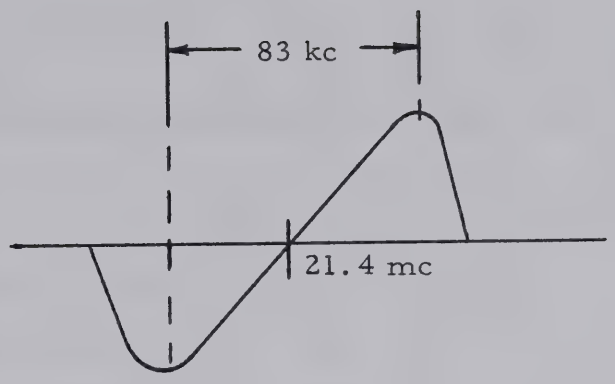


Figure 5-8. 75 Kc IF Amplifier FM Response.

11. 150 Kc Bandwidth IF Amplifier, IF-211-150.

A. Normal Operating Voltages: Table 5-6 is a tabulation of the dc voltages normally encountered on the elements of transistors in the 150 kc IF amplifier. Measurements were made with an RCA Senior Voltohmyst Model WV-98C. Throughout the measurements, the front panel controls were in the following positions:

IF BANDWIDTH KC	150
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR-ON	ON
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for the normal presentation on the signal display unit.

Transistor Symbol Number	Emitter	Base	Collector
Q1	5.9	5.9	9.7
Q2	-5.8	-5.2	-0.62
Q3	-0.62	GND	9.7
Q4	-5.8	-5.2	-0.65
Q5	-0.65	GND	9.8
Q6*	6.0	5.1	11.4
Q7	-0.77	-0.15	10.1
Q8	-2.7	-2.1	-0.72
Q9	-0.72	GND	4.0
Q10	-1.0	-0.4	11.1

*Q6 voltages measured with the function selector in the CW position.

Table 5-6. IF-211-150 Transistor Voltages.

B. Alignment of the 150 Kc Bandwidth IF Amplifier:

(1) Connect the test equipment to the receiver in the manner illustrated in Figure 5-4. Energize the test equipment and allow a warm-up time as indicated by the test equipment manufacturer's specifications.

(2) Position the controls on the front panel of Receiver SR-212 as follows:

TUNING RANGE MC	30-100
Tuning Control	65 mc
IF BANDWIDTH KC	150
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN

controls should be adjusted for the normal presentation on the signal display unit.

(3) Remove the IF-211-150 printed circuit card from its receptacle. Remove the Teflon key from the receptacle. Insert a card extender into the IF-211-150 receptacle. Insert the IF-211-150 printed circuit card into the card extender.

(4) Energize Receiver SR-212 by placing the POWER switch in the ON position.

(5) Adjust Sweep Generator Telonic HD-1A for a frequency output of 65 mcs.

(6) Adjust the horizontal gain of Oscilloscope Tektronix 503 as required for full scale deflection of the horizontal sweep.

(7) Adjust the vertical amplifier of Oscilloscope Tektronix 503 for a 0.5 volts per centimeter of deflection.

(8) Adjust the output of Sweep Generator Telonic HD-1A and Receiver SR-212 RF GAIN control to provide an IF response of 4 centimeters as observed on Oscilloscope Tektronix 503.

(9) Turn the FM-AM/AGC-AM/MAN-CW selector switch to the CW position. A 21.4 mc marker will now be observed on Oscilloscope Tektronix 503.

(10) Turn FM-AM/AGC-AM/MAN-CW selector switch to AM/MAN and adjust Receiver SR-212 tuning control so that the IF response is centered around the 21.4 mc marker.

(11) Adjust L1 through L6 for maximum symmetrical response centered around the 21.4 mcs marker.

(12) Alternately switch the FM-AM/AGC-AM/MAN-CW selector switch from CW to AM/MAN to assure that the response is centered around the 21.4 mc marker. A typical response is shown in Figure 5-9.

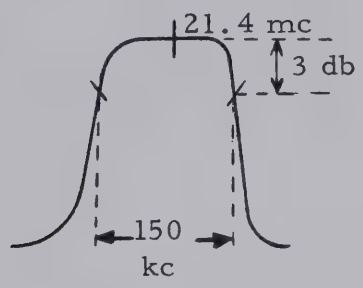


Figure 5-9. 150 Kc IF Amplifier AM Response.

C. FM Alignment of the 150 Kc Bandwidth IF Amplifier:

(1) Connect the test equipment to the receiver as shown in Figure 5-4.

(2) Position the controls on the front panel of Receiver SR-212 as follows:

TUNING RANGE MC	30-100
Tuning Control	65 mc
IF BANDWIDTH KC	150
FM-AM/AGC-AM/MAN-CW	FM
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY and GAIN controls should be adjusted for the normal presentation on the signal display unit.

(3) Repeat steps (3) through (8) of the AM circuit alignment as required to provide an S curve response on the oscilloscope of 4 centimeters peak-to-peak deflection.

(4) Turn the FM-AM/AGC-AM/MAN-CW selector switch to CW. A 21.4 mc marker will now be observed on Oscilloscope Tektronix 503.

(5) Turn the FM-AM/AGC-AM/MAN-CW selector switch to FM and adjust Receiver SR-212 tuning control so that the discriminator response curve is centered around the 21.4 mc marker.

(6) Adjust L8 for maximum amplitude and L9 and L10 for maximum linearity of response. When L10 is adjusted correctly, the 21.4 mc crossover point will occur at the center of the response curve.

(7) Alternately switch the FM-AM/AGC-AM/MAN-CW selector switch from FM to CW to assure that the response is centered around the 21.4 mc marker. A typical response is shown in Figure 5-10.

(8) Deenergize Receiver SR-212 and replace printed circuit card IF-211-150 in its respective receptacle.

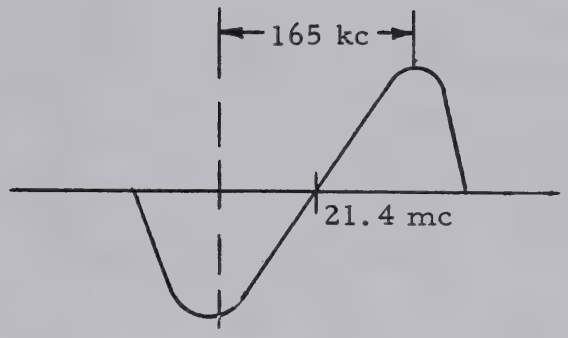


Figure 5-10. 150 Kc IF Amplifier FM Response.

12. 60-21.4 Mc Converter, CV-203.

A. Normal Operating Voltages - Table 5-7, below, is a tabulation of the dc voltages normally encountered on the elements of transistors in the 60-to-21.4 mc converter. All voltages are measured with reference to chassis ground using an RCA Senior Voltohmyst, Model WV-98C. Throughout the measurements, the front panel controls were in the following positions:

IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR-ON	ON
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY and GAIN controls should be adjusted for the normal presentation on the signal display unit.

Transistor Symbol Number	Emitter	Base	Collector
Q1	-0.78	-0.10	5.8
Q2	-0.62	GND	10.0
Q3	-10.0	-9.5	-0.58
Q4	-0.58	GND	8.3
Q5	-0.78	-0.04	11.9
Q6	1.1	1.5	7.7
Q7	-2.8	-2.1	7.0
Q8	-0.64	GND	8.6

Table 5-7. CV-203 Transistor Voltages

B. Alignment of 60-21.4 Mc Converter, CV-203:

(1) Connect the test equipment to the CV-203 module in the manner shown in Figure 5-11. Energize the test equipment and allow a warm-up time as indicated by the test equipment manufacturer's specifications.

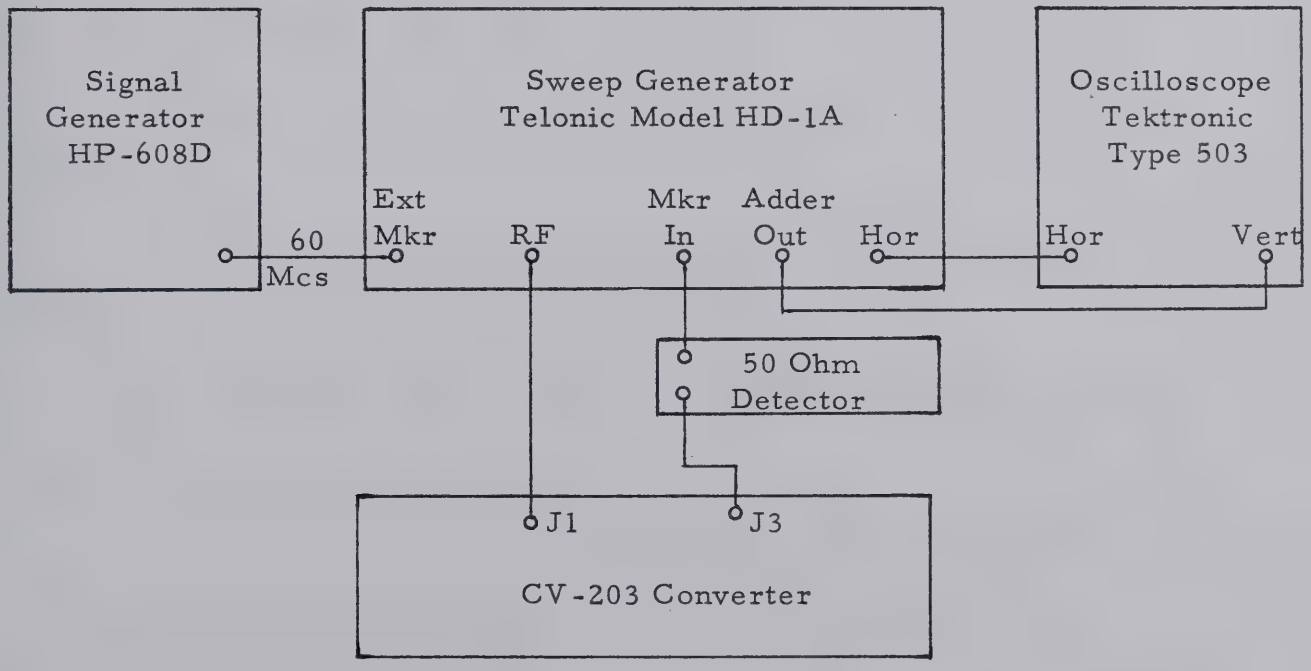


Figure 5-11. Test Configuration for CV-203 Alignment.

(2) Position the controls on the front panel of Receiver SR-212 as follows:

TUNING RANGE MC	250-500
Tuning Control	250 mc
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for normal presentation on the signal display unit.

(3) Adjust Signal Generator HP-608D for a frequency output of 60 mcs. A frequency counter, the zero beat technique, or another accurate method should be used to obtain this frequency.

(4) Adjust Sweep Generator Telonic HD-1A for a frequency output of 60 mcs.

(5) Adjust horizontal gain of Oscilloscope Tektronix 503 as required for full scale deflection of the horizontal sweep.

(6) Adjust the vertical amplifier of Oscilloscope Tektronix 503 for a 0.5 volts per centimeter of deflection.

(7) Adjust the output of Sweep Generator Telonic HD-1A to provide a response of 4 centimeters as indicated on Oscilloscope Tektronix 503.

(8) Adjust signal generator output control and sweep generator marker control to provide a small 60 mc marker on the response curve displayed on the oscilloscope.

(9) Adjust inductances L1 through L4 for maximum symmetrical response centered around the 60 mc marker. Reduce the output of the sweep generator as required to maintain a constant amplitude of the response curve displayed on the oscilloscope. The response curve should exhibit the characteristics illustrated in Figure 5-12.

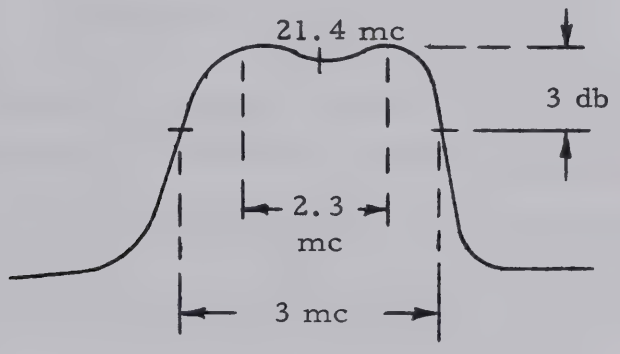


Figure 5-12. CV-203 Converter Response Curve.

(10) After the alignment has been completed, disconnect cables from J1 and J3. Connect interconnecting receiver cables to J1 and J3. The 21.4 mc preamplifier portion of the 60-21.4 mc converter may now be aligned.

C. Alignment of CV-203, 21.4 Mc Preamplifier:

(1) Connect the test equipment to the CV-203 module in the manner shown in Figure 5-13.

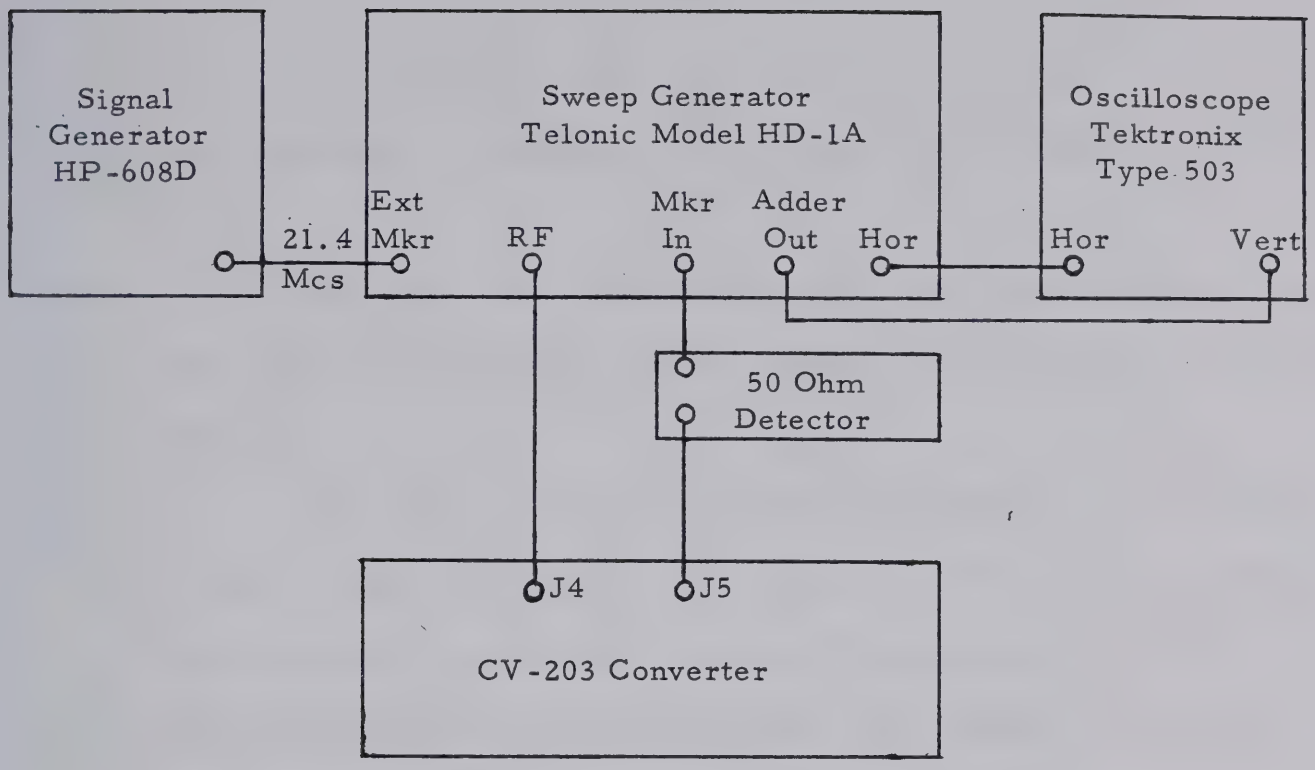


Figure 5-13. 21.4 Mc Preamplifier Alignment.

(2) Position the controls on the front panel of Receiver SR-212 as indicated in paragraph 12, B, (2) for the 60-21.4 mc converter alignment procedure.

(3) Adjust Signal Generator HP-608D for a frequency output of 21.4 mcs. A frequency counter, the zero beat technique, or another accurate method should be used to obtain this frequency.

(4) Adjust Sweep Generator Telonic HD-1A for a frequency output of 21.4 mcs.

(5) Adjust horizontal gain of oscilloscope Tektronix 503 as required for full scale deflection of the horizontal sweep.

(6) Adjust the vertical amplifier of Oscilloscope Tektronix 503 for a 10 millivolts per centimeter of deflection.

(7) Adjust the output of Sweep Generator Telonic HD-1A to provide a response of 4 centimeters as indicated on Oscilloscope Tektronix 503.

(8) Adjust the output of Sweep Generator Telonic HD-1A to provide a small 21.4 mc marker on the response curve displayed on the oscilloscope.

(9) Adjust inductances L6 and L7 for maximum symmetrical response centered around the 21.4 mc marker. Reduce the output of the sweep generator as required to maintain a constant amplitude of the response curve displayed on the oscilloscope. The response curve should exhibit the characteristics illustrated in Figure 5-14.

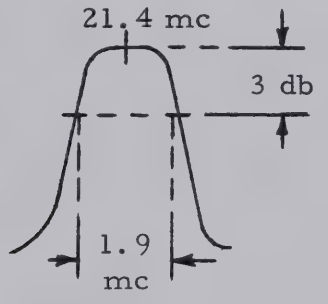


Figure 5-14. 21.4 Mc Preamplifier Response Curve.

(10) This completes the alignment of the CV-203 converter. Remove the cables connecting the test equipment. Connect receiver interconnecting cables to J4 and J5.

13. 30-100 Mc Tuner, SH-211-1.

A. Normal Operating Voltages: Table 5-8, is a tabulation of the dc voltages normally encountered on the elements of transistors in the

30-100 mc tuner. All voltages are measured with reference to chassis ground using an RCA Senior Voltohmyst Model WV-98C. Throughout the measurements the front panel controls were in the following positions:

TUNING RANGE MC	30-100
Tuning Control	30 mc
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	Off
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for normal presentation on the signal display unit.

Transistor Symbol Number	Emitter	Base	Collector
Q1	0.27	GND	-6.0
Q2	0.27	GND	-4.0
Q3	6.0	6.0	0.15
Q4	0.15	GND	-5.6
Q5	-5.3	-6.0	3.3

Table 5-8. SH-211-1 Transistor Voltages.

B. Alignment of the SH-211-1 Local Oscillator:

(1) Connect the test equipment to the receiver in the manner indicated in Figure 5-15. Energize the test equipment and allow a warm-up time as indicated by the test equipment manufacturer's specifications.

(2) Position the front panel controls of Receiver SR-212 in the positions of paragraph A, above.

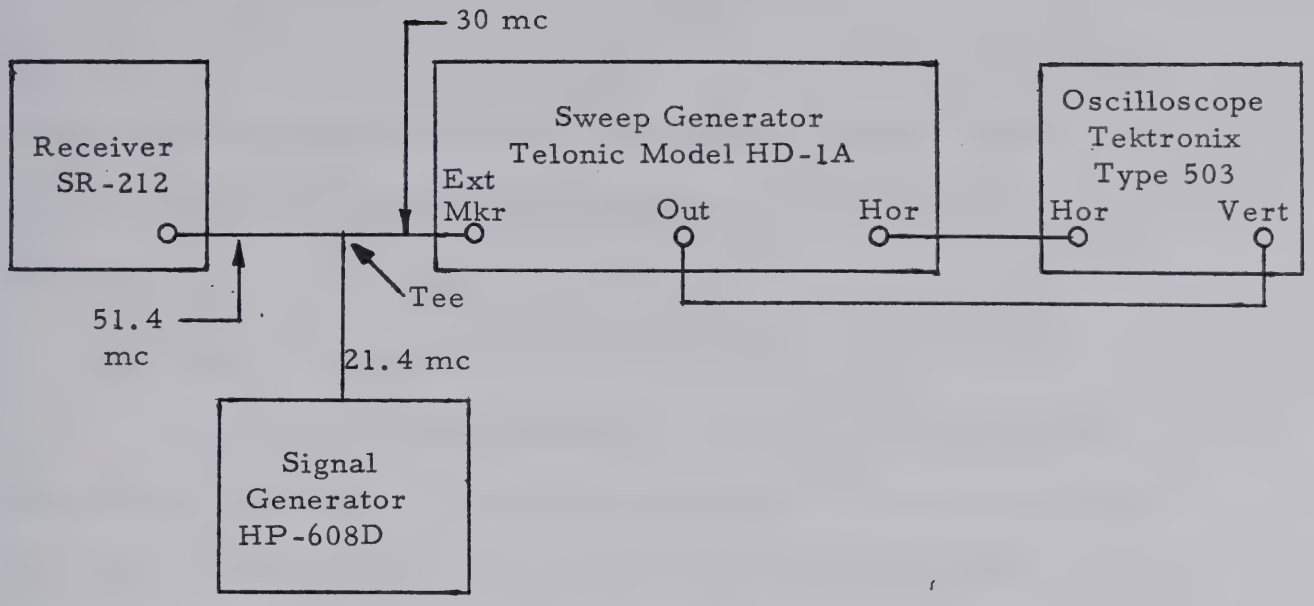


Figure 5-15. Test Setup for SH-211-1 Oscillator Alignment.

(3) Energize Receiver SR-212 by placing the POWER switch in the ON postion.

(4) Adjust horizontal gain of Oscilloscope Tektronix 503 for full scale deflection of the horizontal sweep.

(5) Adjust the vertical amplifier of Oscilloscope Tektronix 503 for 10 millivolts per centimeter of deflection.

(6) Adjust the output of Signal Generator HP-608D for 21.4 mcs. A frequency counter, the zero beat technique or some other accurate method should be used to set this output frequency.

(7) Observe the signals present on Oscilloscope Tektronix 503. The LO signal should be superimposed on the 30 mc marker signal. If this is not the case, adjust C49 for this condition.

(8) Further alighment of the LO must be effected using the end

inductor and field adjustment is not recommended. Should adjustment of the end inductor be required, it is suggested that the unit be returned to the factory for a complete realignment.

C. Alignment of the SH-211-1 IF Amplifier:

(1) Connect the test equipment to the receiver in the manner indicated in Figure 5-16. The cable attached to the IF output connector, J2, must be disconnected to permit the connection of the 50 ohm detector. Caution should be exercised when attaching the output from the sweep generator to the emitter of transistor Q4 not to disturb the placement of any of the components in the tuner. Energize the test equipment and allow a warm-up time as indicated by the test equipment manufacturer's specifications.

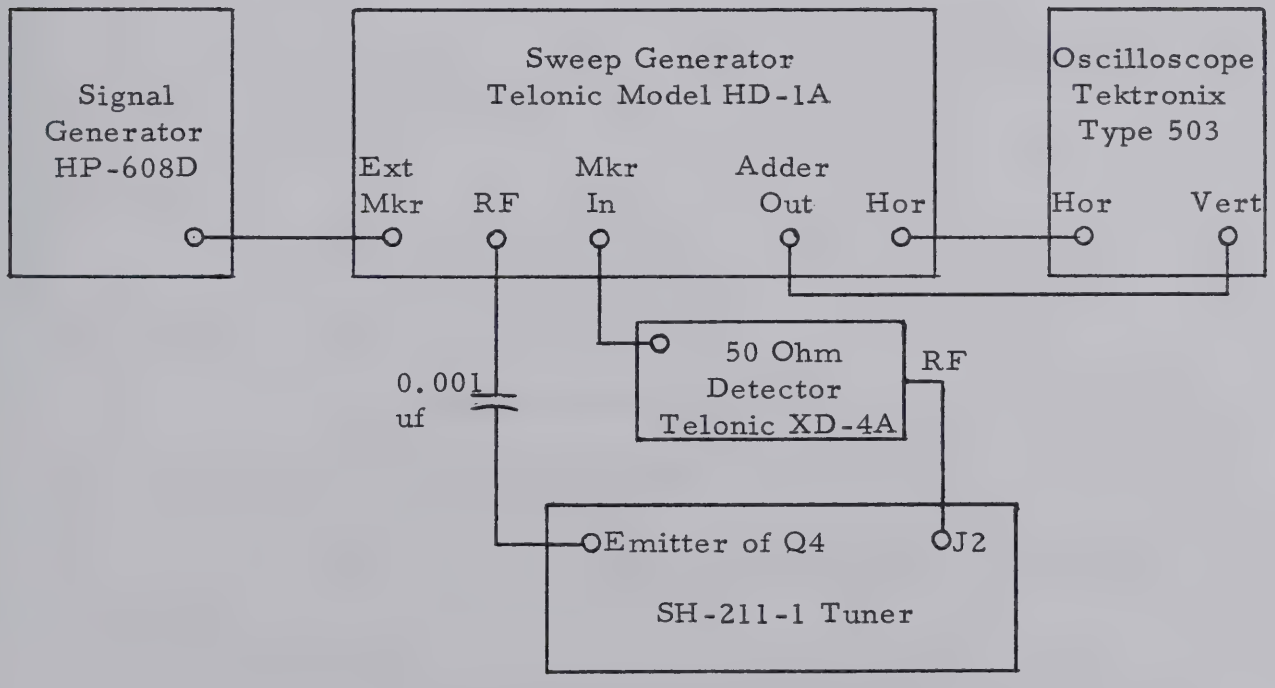


Figure 5-16. Test Setup for SH-211-1 IF Alignment.

(2) Position the controls on the front panel of Receiver SR-212

as follows:

TUNING RANGE MC	30-100
Tuning Control	30 mc
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	Off
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for the normal presentation on the signal display unit.

(3) Energize Receiver SR-212 by placing the POWER switch in the ON position.

(4) Accurately set Signal Generator HP-608D to 21.4 mc using an electronic counter, the zero beat technique, or some other accurate method.

(5) Adjust the output frequency of the Sweep Generator Telonic HD-1A to 21.4 mc.

(6) Adjust the horizontal gain of Oscilloscope Tektronix 503 as required to achieve full scale horizontal deflection.

(7) Adjust the vertical gain of Oscilloscope Tektronix 503 to 10 mv/cm.

(8) Adjust the output level of the Sweep Generator Telonic HD-1A as required to achieve a peak to peak deflection on the Oscilloscope

Tektronix 503 of approximately 5 cm. The response must not give evidence of saturation or overloading.

(9) Adjust the output of Signal Generator HP-608D and the marker gain controls on the Sweep Generator Telonic HD-1A to achieve a small 21.4 mc "birdie" on the response.

(10) Adjust inductors L14 and L15 for maximum symmetrical response centered around the 21.4 mc marker. Reduce the output level of the sweep and marker generators as required to avoid saturation or overloading of the response.

(11) The resulting IF response should exhibit the characteristics shown in Figure 5-17, below.

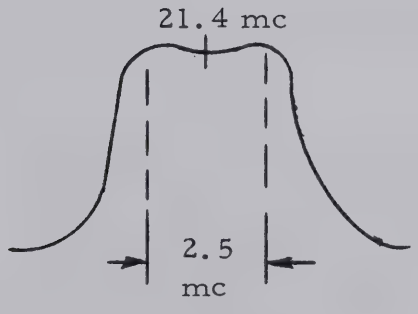


Figure 5-17. Typical SH-211-1 IF Response.

(12) This completes the IF alignment of the SH-211-1 and all test equipment should be removed and the receiver reassembled.

D. Alignment of the SH-211-1, RF Amplifier:

(1) Connect the test equipment to the receiver in the manner illustrated in Figure 5-18. A suitable detector may be fabricated from the schematic diagram shown in Figure 5-19. Energize the test equipment and allow a warm-up time as indicated by the test equipment manufacturer's specifications.

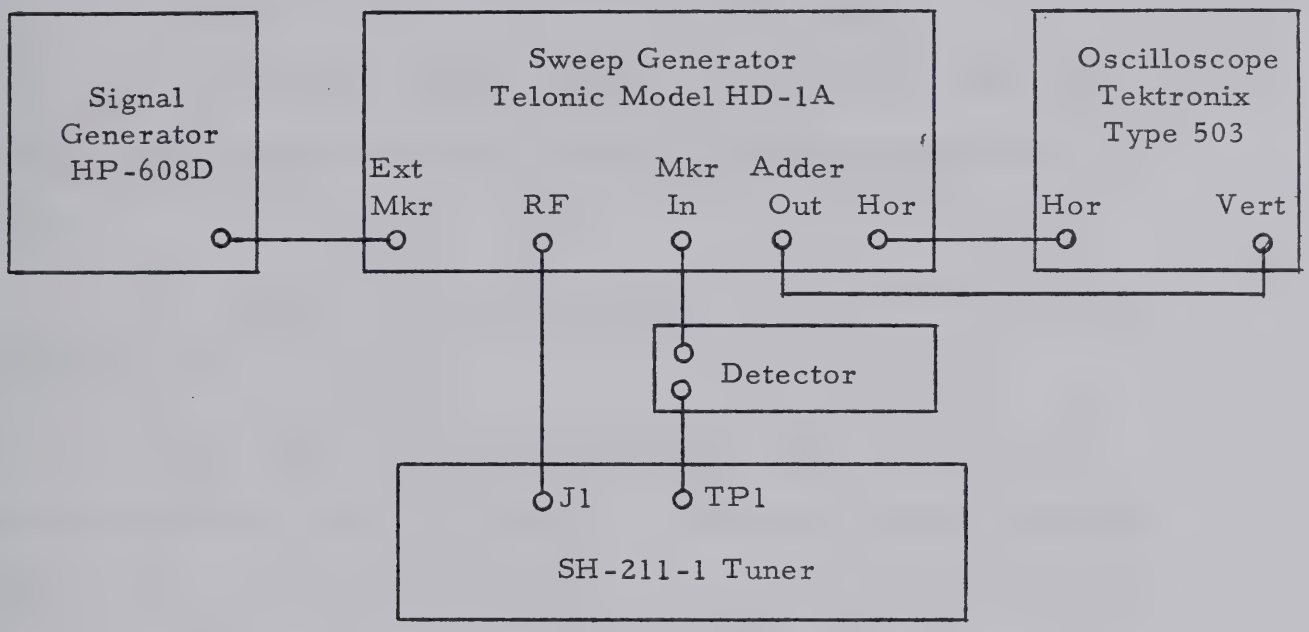


Figure 5-18. Test Setup for SH-211-1 RF Alignment.

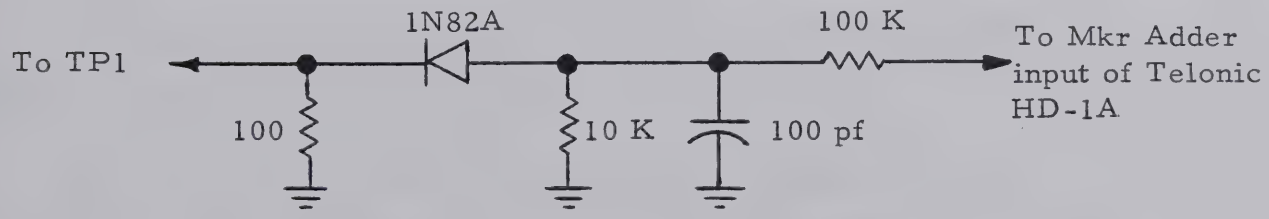


Figure 5-19. SH-211-1 RF Detector.

(2) Position the controls on the front panel of Receiver SR-212 as follows:

TUNING RANGE MC	30-100
Tuning Control	100 mc
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for the normal presentation on the signal display unit.

(3) Energize Receiver SR-212 by placing the POWER switch in the ON position.

(4) Accurately set the Signal Generator HP-608D to 100 mc using an electronic counter, the zero beat technique, or another accurate method.

(5) Set the output frequency of Sweep Generator Telonic HD-1A to 100 mc.

(6) Adjust the horizontal gain of Oscilloscope Tektronix 503 as required to achieve full scale deflection.

(7) Set the vertical gain of Oscilloscope Tektronix 503 to 10 mv/cm and adjust the output level of signal generator HP-608D as required to achieve a deflection of approximately 5 cm.

(8) Adjust the output level of Signal Generator HP-608D as required to achieve a small 100 mc "birdie" on the response.

(9) Adjust C3, C7, C20, C24, and C27 for maximum symmetrical response centered around the 100 mc marker.

(10) This completes the alignment of the RF section of the SH-211-1 tuner and all test equipment should be removed. Reinstall all covers and place the unit back in service. Further adjustment to the RF section may be achieved only by adjustment of the end inductors in the tuner. Field adjustment of these tuning elements is not recommended. Should such adjustments seem necessary, the unit should be returned to the factory for complete realignment.

14. 90-260 Mc Tuner, SH-212-1.

A. Normal Operating Voltages - Table 5-9, below, is a tabulation of the voltages normally encountered on the elements of transistors in the 90-260 mc tuner. All voltages are measured with reference to chassis ground using an RCA Senior Voltohmyst Model WV-98C. Throughout the measurements the receiver front panel controls were in the following positions:

TUNING RANGE MC	90-260
Tuning Control	90
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls

should be adjusted for normal presentation on the signal display unit.

Transistor Symbol Number	Emitter	Base	Collector
Q1	0.98	1.6	6.0
Q2	-0.71	GND	6.7
Q3	-9.4	-9.6	-0.68
Q4	-0.5	GND	7.4
Q5	-5.5	-6.4	6.2

Table 5-9. SH-212-1 Transistor Voltages.

B. Alignment of the SH-212-1 Local Oscillator - The test configuration and component adjustment for the local oscillator alignment is identical as that for the SH-211-1 tuner. The alignment procedure of paragraph 13, B may, therefore, be used to effect correct local oscillator adjustment. During the local oscillator alignment procedure adjust the controls on the front panel of Receiver SR-212 as indicated in paragraph 14, A, above.

C. Alignment of the SH-212-1 IF Amplifier - Use the alignment procedures of paragraph 13, C for the alignment of the SH-212-1 IF amplifier. Position the front panel controls of Receiver SR-212 as indicated in paragraph 14, A.

D. Alignment of the SH-212-1 RF Amplifier - Use the alignment procedure of paragraph 13, D for the alignment of the SH-212-1 RF amplifier. Position the front panel controls of Receiver SR-212 as indicated in paragraph 14, A with the exception of the tuning control which should be set to 260 mc.

15. 250-500 Mc Tuner, SH-213-1.

A. Normal Operating Voltages - Table 5-10, below, is a tabulation of the voltages normally encountered on the elements of transistors in the 250-500 mc tuner. All voltages are measured with reference to chassis ground using an RCA Senior Voltohmyst Model WV-98C. Throughout the measurements the front panel controls were in the following positions:

TUNING RANGE MC	250-500
Tuning Control	250 mc
IF BANDWIDTH KC	20
FM-AM/MAN-AM/AGC-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for normal presentation on the signal display unit.

Transistor Symbol Number	Emitter	Base	Collector
Q1	0.27	GND	-6.0
Q2	0.27	GND	-4.0
Q3	6.1	6.0	0.15
Q4	0.15	GND	-5.6
Q5	-5.3	-6.0	3.3

Table 5-10. SH-213-1 Transistor Voltages.

B. Alignment of the SH-213-1 Local Oscillator:

(1) Connect the test equipment to the receiver in the manner

illustrated in Figure 5-20. Energize the test equipment and allow a warm-up time as indicated by the test equipment manufacturer's specifications.

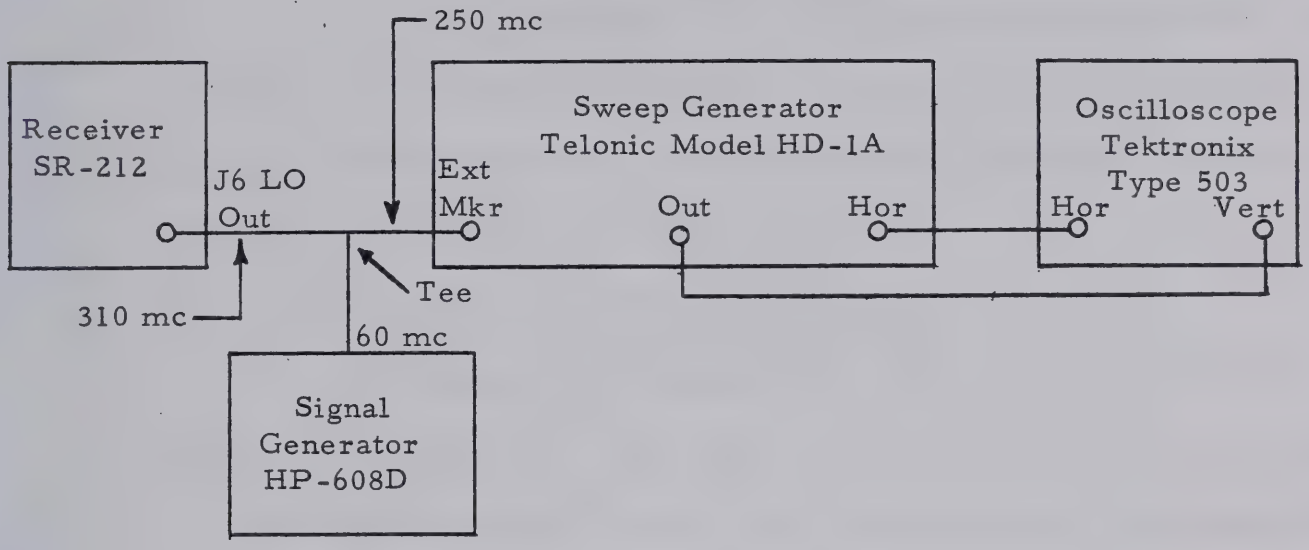


Figure 5-20. Test Setup for SH-213-1 Oscillator Alignment.

(2) Position the front panel controls of Receiver SR-212 in the positions of paragraph 15, A, above.

(3) Energize Receiver SR-212 by placing the POWER switch in the ON position.

(4) Adjust horizontal gain of Oscilloscope Tektronix 503 for full scale deflection of the horizontal sweep.

(5) Adjust the vertical amplifier of Oscilloscope Tektronix 503 for 10 millivolts per centimeter of deflection.

(6) Adjust the output of Signal Generator HP-608D for 60 mc. A frequency counter, the zero beat technique, or some other accurate method should be used to set this output frequency.

(7) Observe the signals present on Oscilloscope Tektronix 503.

The LO signal should be superimposed on the 60 mc marker signal. If this is not the case, adjust C29 for this condition.

(8) Further alignment of the LO must be effected using the end inductor, and field adjustment is not recommended. Should adjustment of the end inductor be required, it is suggested that the unit be returned to the factory for a complete realignment.

C. Alignment of the SH-213-1 IF Amplifier:

(1) Connect the test equipment to the receiver in the manner illustrated in Figure 5-21. The cable attached to the IF output connector, J2, must be disconnected to permit the connection of the 50 ohm detector. Caution should be exercised when attaching the output from the sweep generator to the base of transistor Q3 not to disturb the placement of any of the components in the tuner. Energize the test equipment and allow a warm-up time as indicated by the test equipment manufacturer's specifications.

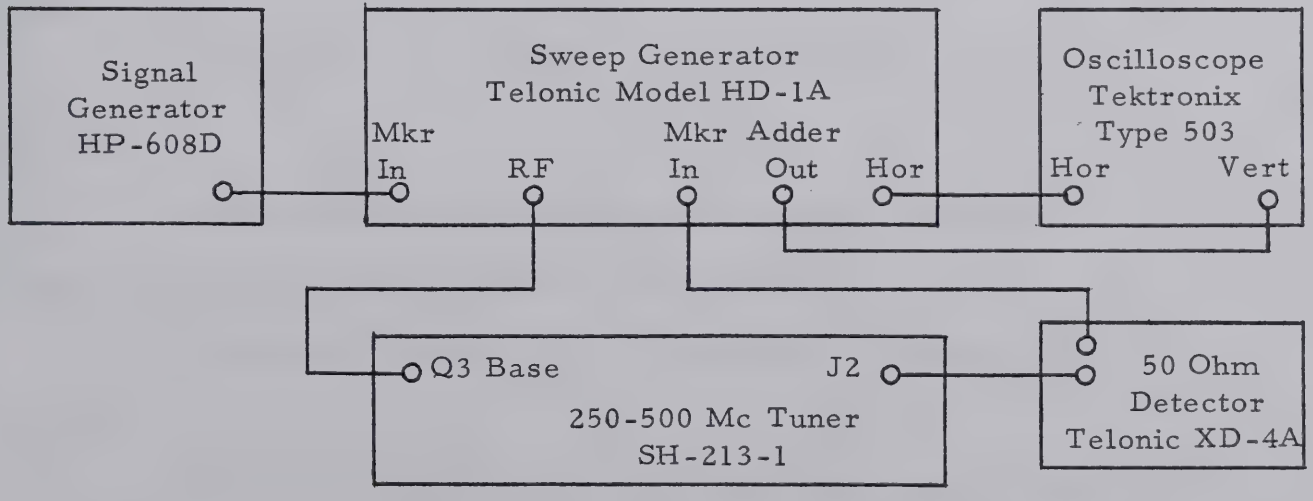


Figure 5-21. Test Setup for SH-213-1 IF Alignment.

(2) Position the controls on the front panel of Receiver SR-212 as follows:

TUNING RANGE MC	250-500
Tuning Control	250 mc
IF BANDWIDTH KC	20
FM-AM/MAN-AM/AGC-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN control should be adjusted for normal presentation on the signal display unit.

(3) Energize Receiver SR-212 by placing the POWER switch in the ON position.

(4) Accurately set the Signal Generator HP-608D to 60 mcs using an electronic counter, the zero beat technique, or some other accurate method.

(5) Adjust the output of Sweep Generator Telonic HD-1A to 60 mcs.

(6) Adjust the horizontal gain of Oscilloscope Tektronix 503 as required to achieve full scale horizontal deflection.

(7) Adjust the vertical gain of Oscilloscope Tektronix 503 to 20 mv/cm.

(8) Adjust the output level of Sweep Generator Telonic HD-1A

as required to achieve a deflection on Oscilloscope Tektronix 503 of 4 cm or approximately 80 mv. The response must not give evidence of saturation or overloading.

(9) Adjust output of Signal Generator HP-608D and the marker gain controls on Sweep Generator Telonic HD-1A to achieve a small 60 mc "birdie" on the response.

(10) Adjust inductors L8 and L9 for maximum symmetrical response centered around the 60 mc marker. Reduce the output level of the sweep generator as required to avoid saturation or overloading of the response.

(11) The resulting IF response should exhibit the characteristics shown in Figure 5-22.

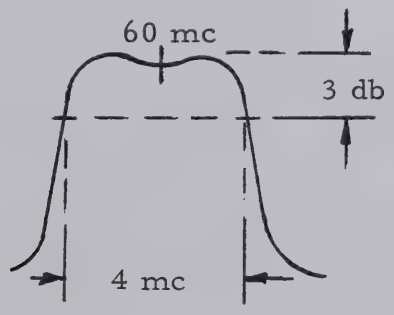


Figure 5-22. Typical SH-213-1 IF Response.

(12) This completes the IF alignment of the SH-213-1 tuner. Remove all test equipment and reassemble the receiver.

D. Alignment of the SH-213-1 RF Amplifier: The RF alignment of the tuner is quite critical and no attempt should be made to perform an

alignment in the field unless it is absolutely necessary. In the event alignment is necessary, the following alignment procedure may be used.

(1) Connect the test equipment to the receiver in the manner illustrated in Figure 5-23. Energize the test equipment and allow a warm-up time as indicated by the test equipment manufacturer's specifications. A suitable detector may be fabricated from the schematic diagram shown in Figure 5-19.

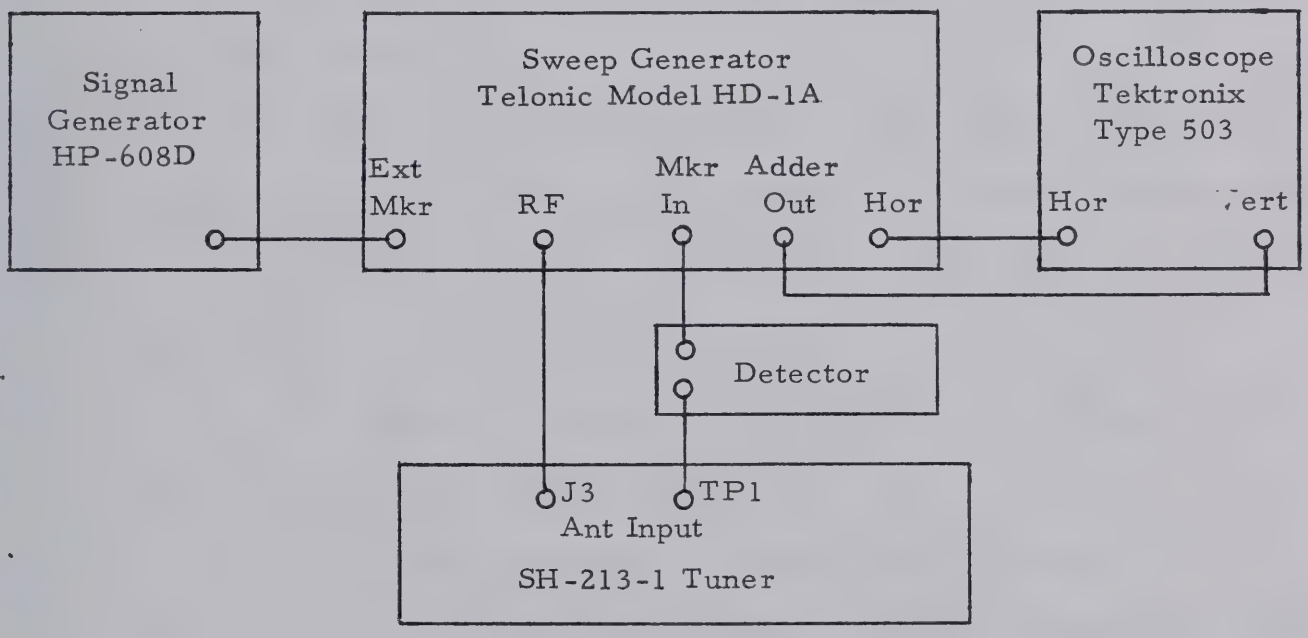


Figure 5-23. Test Setup for SH-213-1 RF Alignment.

(2) Position the controls on the front panel of Receiver SR-212 as follows:

TUNING RANGE MC	250-500
Tuning Control	400 mc
IF BANDWIDTH KC	20

FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	Off
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for normal presentation on the signal display unit.

(3) Energize Receiver SR-212 by placing the POWER switch in the ON position.

(4) Accurately set Signal Generator HP-608D to 400 mc using an electronic counter, the zero beat technique, or another accurate method.

(5) Set the output frequency of Sweep Generator Telonic HD-1A to 250 mc.

(6) Adjust the horizontal gain of Oscilloscope Tektronix 503 as required to achieve full scale deflection.

(7) Set the vertical gain of Oscilloscope Tektronix 503 to 10 mv/cm and adjust the output level of Signal Generator HP-608D as required to achieve a deflection of approximately 5 cm.

(8) Peak C3, C5, C10, C12, and C18 for maximum amplitude as observed on Oscilloscope Tektronix 503.

(9) This completes the RF alignment of the SH-213-1 tuner. Further alignment of the RF amplifier is accomplished by adjustment of the fixed end inductors; this alignment is not recommended in the field.

When it has been established that the RF alignment cannot be corrected by the procedure described above, it is suggested that the unit be returned to the factory for a complete realignment.

16. 490-1000 Mc Tuner, SH-204-2.

A. Normal Operating Voltages: The transistor voltages normally encountered on the elements of transistors in an operating SH-204-2 tuner are provided in Table 5-11, below. All voltages are measured with reference to chassis ground using an RCA Senior Voltohmyst Model WV-98C. Throughout the measurements the receiver front panel controls were in the following positions:

TUNING RANGE MC	490-1000
Tuning Control	500
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	Off
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for normal presentation on the signal display unit.

Transistor Symbol Number	Emitter	Base	Collector
Q1	5.8	5.6	13.0
Q2	5.8	5.6	0.28
Q3	0.28	0	-6.2

Table 5-11. SH-204-2 Transistor Voltages.

B. Alignment of the SH-204-2 Local Oscillator:

(1) Connect Signal Generator HP-612A to J4, the RF input of the 490-1000 mc tuner SH-204-1, with a short length of coaxial cable. Energize Signal Generator HP-612A and allow a warm-up time as indicated by the test equipment manufacturer's specifications.

(2) Position the front panel controls of Receiver SR-212 in the positions of paragraph 16, A.

(3) Energize Receiver SR-212 by placing the POWER switch in the ON position.

(4) Adjust the output of Signal Generator HP-612A to 500 mc. A frequency counter, the zero beat technique, or some other accurate method should be used to set this output frequency.

(5) Increase the output of Signal Generator HP-612A to 100 micorvolts.

(6) Adjust capacitor C9 to obtain center tuning on the signal display unit and a maximum indication on the signal strength meter.

(7) Tune Signal Generator HP-612A and Receiver SR-212 to 1000 mc.

(8) Adjust capacitor C6 to obtain center tuning on the signal display unit and a maximum indication on the signal strength meter.

C. Alignment of the SH-204-2, 60 Mc IF Amplifier:

(1) Connect the test equipment to the receiver in the manner illustrated in Figure 5-24. Energize the test equipment and allow a warm-

up time as indicated by the test equipment manufacturer's specifications.

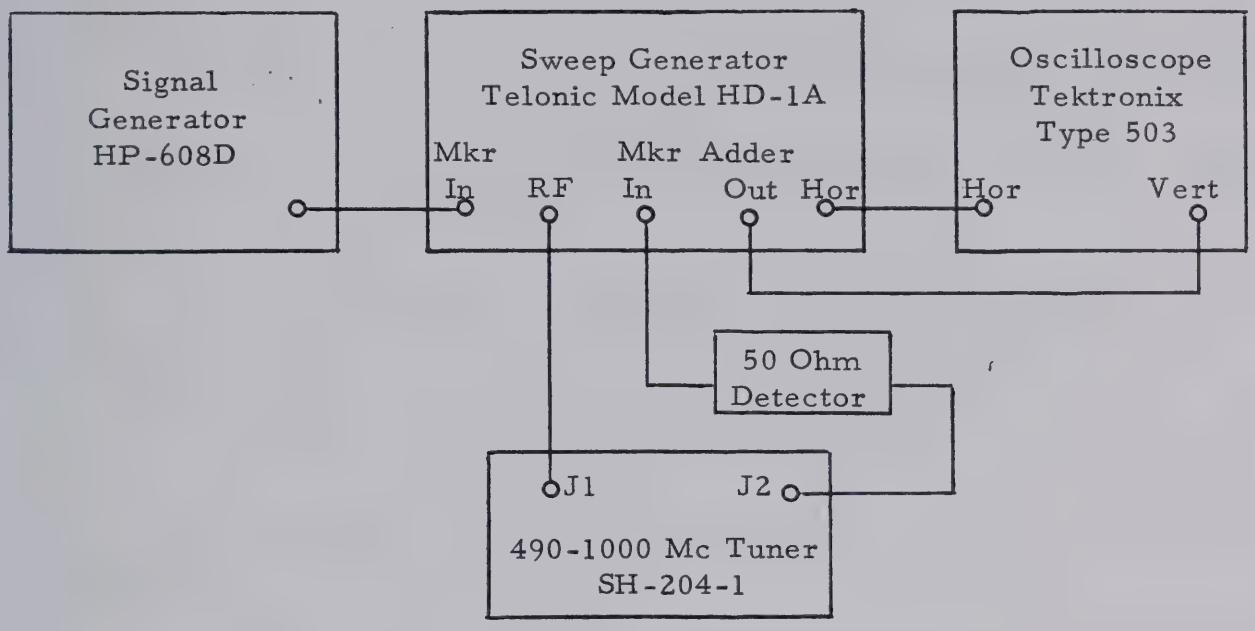


Figure 5-24. Test Setup for SH-204-2 Alignment.

(2) Position the front panel controls of Receiver SR-212 in the positions of paragraph 16, A.

(3) Energize Receiver SR-212 by placing the POWER switch in the ON position.

(4) Adjust Signal Generator HP-612A for an output of 60 mc. A frequency counter, the zero beat technique, or some other accurate method may be used to set this frequency.

(5) Adjust the output frequency of Sweep Generator Telonic HD-1A to 60 mc.

(6) Adjust the horizontal gain of Oscilloscope Tektronix 503 as required to achieve full scale horizontal deflection.

(7) Adjust the vertical gain of Oscilloscope Tektronix 503 to 10 mv/cm.

(8) Adjust the output level of Sweep Generator Telonic HD-1A and Signal Generator HP-608D as required to achieve a response on Oscilloscope Tektronix 503 of 5 cm.

(9) Adjust the marker gain control on Sweep Generator Telonic HD-1A to achieve a small 60 mc "birdie" on the response.

(10) Loosen lock-nuts and adjust inductors L12 and L13 for a maximum symmetrical double tuned response centered around the 60 mc marker.

(11) The resulting IF response should exhibit the characteristics shown in Figure 5-25.

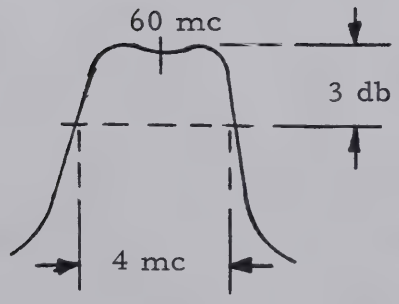


Figure 5-25. SH-204-2, 60 Mc IF Response.

(12) After the alignment has been completed, tighten the locknuts on inductors L12 and L13 while observing the response to make certain that it does not change. This completes the IF alignment of the SH-204-2 tuner.

D. Crystal Current Adjustment:

(1) Connect a 0-5 center scale milliammeter to J3.

(2) Energize Receiver SR-212 by placing the POWER switch in the ON position.

(3) Vary the tuning control for the 490-1000 mc tuner across its frequency range while observing the oscillator injection current on the milliammeter. The current should vary between 0.5 and 1.5 ma.

(4) If correct readings of crystal current cannot be obtained across the frequency range of the tuner, it is probably due to a defective mixer diode CR1. The diode is mounted inside the tuner module on a spring clip holder and can easily be replaced.

E. RF Preselector: The RF preselector has been carefully aligned at the factory and should require no further adjustments. Under no circumstances should any adjustments be attempted in the field. If the unit cannot be placed in service utilizing the procedures outlined herein, it is recommended that it be returned to the factory for repair.

17. AGC Module, AGC-204.

A. Normal Operating Voltages: Table 5-12, below, is a tabulation of the dc voltages normally encountered on the elements of transistors in

an operating AGC-204 module. All voltages are measured with reference to chassis ground using an RCA Senior Voltohmyst Model WV-98C. Throughout the measurements the front panel controls were in the following positions.

TUNING RANGE MC	30-100
Tuning Control	30 mc
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for normal presentation on the signal display unit.

Transistor Symbol Number	Emitter	Base	Collector
Q1	-1.0	-0.6	12.0
Q2	-1.8	-1.0	12.0
Q3	-7.8	-7.2	13.4
Q4	GND	-0.18	0.04
Q5	0.14	0.56	24.0
Q6	-0.4	0.14	16.0
Q7	0	-0.16	12.0
Q8	-1.4	-0.85	12.0
Q9	-1.9	-1.4	12.0
Q10	-8.0	-0.75	14.0
Q11	GND	0.55	0.04
Q12	0.14	0.56	24.0
Q13	-0.38	0.14	16.0
Q14	1.6	0.93	-0.84
Q15	-0.47	-0.84	-12.0
Q16	0	-0.47	-12.0

Table 5-12. AGC-204 Transistor Voltages.

B. AGC Threshold Adjustment of 3 Mc IF:

(1) Connect the test equipment to the receiver in the manner illustrated in Figure 5-26. Energize the test equipment and allow a warm-up time as indicated by the test equipment manufacturer's specifications.

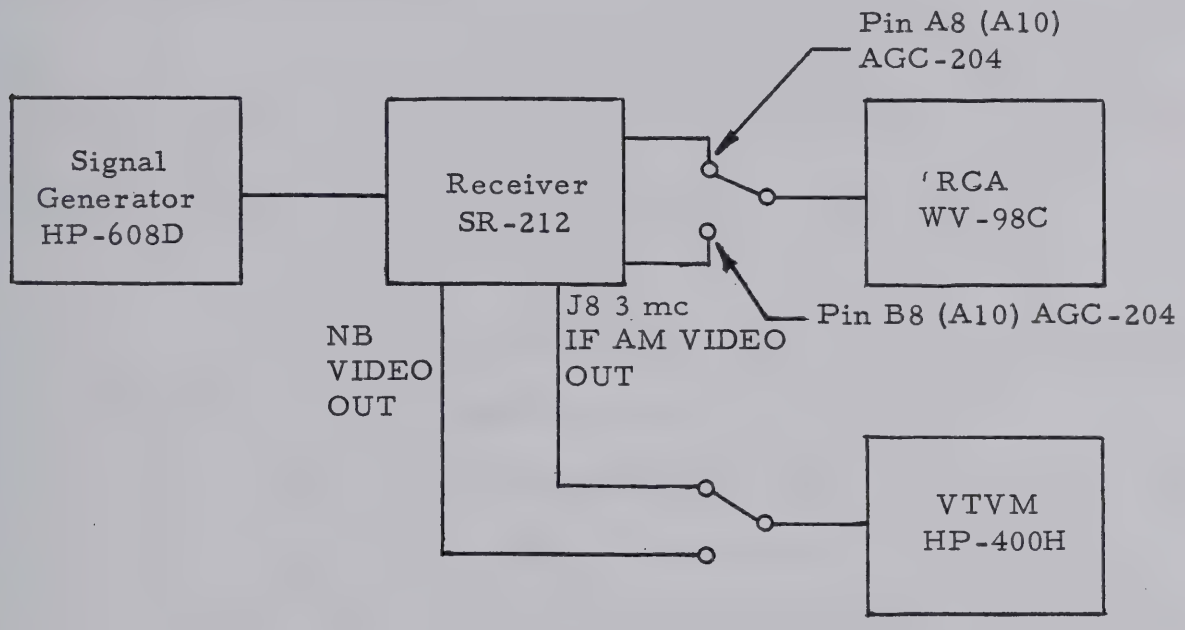


Figure 5-26. Test Setup for AGC Adjustment.

(2) With the front panel control of Receiver SR-212 in the positions indicated in paragraph 17, A, place the FM-AM/AGC-AM/MAN selector switch in the AM/AGC position.

(3) Energize Receiver SR-212 by placeing the POWER switch in the ON position.

(4) Adjust Signal Generator HP-608D for a 7 microvolt output signal at 65 mcs.

(5) Adjust tuning control on Receiver SR-212 to center the

signal generator output signal on the signal display unit.

(6) Adjust R9 on the AGC-204 module until the AGC voltage as indicated on the WV-98C just comes on. The WV-98C should indicate approximately 0.25 volts.

(7) Decrease Signal Generator HP-608D output level to 3.5 microvolts. Position front panel controls of the signal generator to amplitude modulate the output signal 50 percent at 1000 cps.

(8) Record the reading in db indicated on the HP-400H.

(9) Increase the output level of Signal Generator HP-608D 70 db above 3.5 microvolts (approximately 11 millivolts).

(10) Record the indicated reading on the HP-400H in db. Compare this reading with the reading recorded in step (8). The difference in the recorded readings should not be more than 7 db as indicated in the Section II Specification data.

(11) If the difference in recorded readings is greater than 7 db, adjust R9 and repeat steps (7) through (10) until a difference reading of 7 db or less can be obtained.

C. AGC Threshold Adjustment for Narrow Band IF:

(1) Connect the test equipment to the receiver in the manner illustrated in Figure 5-26. Use a 93 ohm load between J7 NB VIDEO OUTPUT connector and the HP-400H.

(2) With the front panel controls of Receiver SR-212 in the positions indicated in paragraph 17, A, place the FM-AM/AGC-AM/MAN-CW

selector switch in the AM/AGC position and the IF BANDWIDTH KC switch in the 150 kc position.

(3) Energize Receiver SR-212 by placing the POWER switch in the ON position.

(4) Adjust Signal Generator HP-608D for a 3 microvolt output signal at 65 mcs.

(5) Adjust tuning control on Receiver SR-212 to center the signal generator output signal on the signal display unit.

(6) Adjust R26 on the AGC-204 module until the AGC voltage as indicated on the WV-98C just comes on. The WV-98C should indicate approximately 0.25 volts.

(7) Decrease Signal Generator HP-608D output level to 3.5 microvolts. Position front panel controls of the signal generator to amplitude modulate the output signal 50 percent at 1000 cps.

(8) Adjust VIDEO GAIN control on Receiver SR-212 to provide a reference reading on the HP-400H. Record this reading in db.

(9) Increase the output level of Signal Generator HP-608D 70 db above 3.5 microvolts (approximately 11 millivolts).

(10) Record the indicated reading on the HP-400H in db. Compare this reading with the reading recorded in step (9). The difference in the recorded readings should not be more than 7 db as indicated in the Section II, Specification data.

(11) If the difference in recorded readings is greater than 7 db,

adjust R26 and repeat steps (7) through (11) until a difference reading of 7 db or less can be obtained.

(12) Repeat the above procedures for each position of the SR-212 IF BANDWIDTH KC switch.

(13) This completes the AGC threshold adjustment of the narrow band IF's. Remove all test equipment connected to the receiver.

18. Receiver Noise Figure Measurement.

A. Connect the test equipment to the receiver in the manner illustrated in Figure 5-26. Use VHF Noise Source HP-343A for measurements of noise figure on Band 1 and 2 tuners. Use UHF Noise Source HP-349A for measurements of noise figure on Band 3 and 4 tuners. Energize test equipment and allow a warm-up time as indicated by the test equipment manufacturer's specifications.

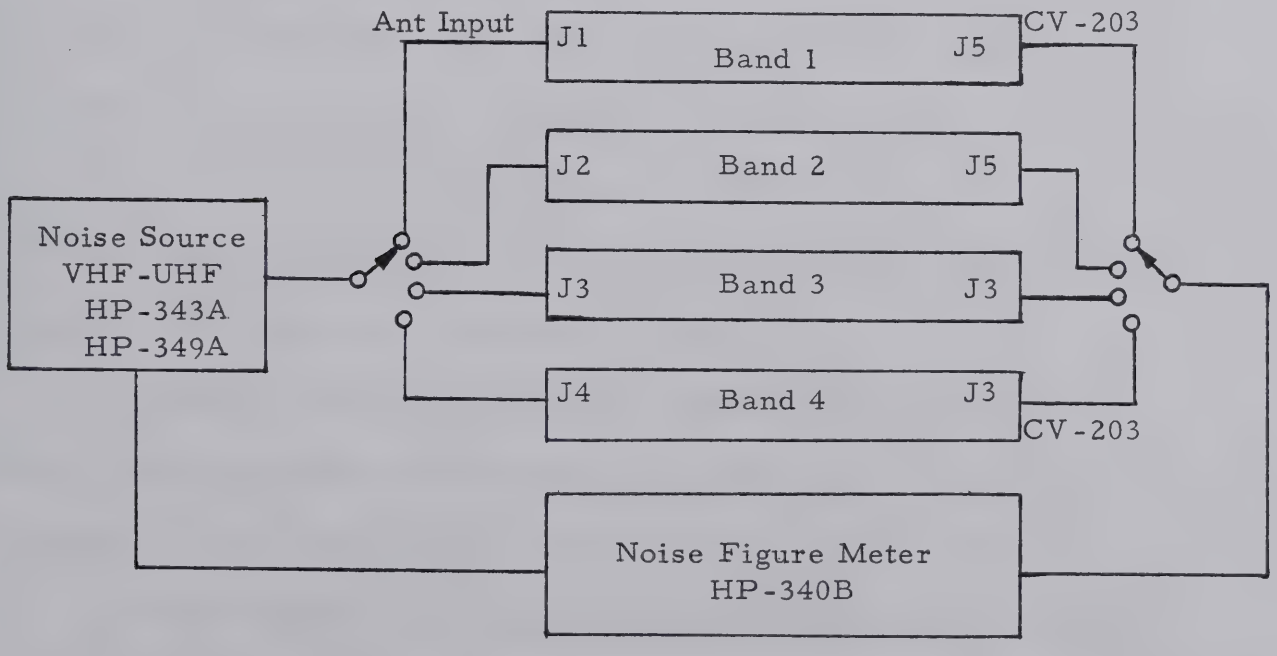


Figure 5-27. Test Setup for Noise Figure Measurement.

B. Position the front panel controls of Receiver SR-212 as follows:

TUNING RANGE MC	As Required
Tuning Control	As Required
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	Off
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for normal presentation on the signal display unit.

C. Energize Receiver SR-212 by placing the POWER switch in the ON position.

D. Position TUNING RANGE MC switch to the desired tuning range for which noise figure measurements are to be made. Position tuning control to the low end of the tuning range.

E. Adjust the front panel controls of Noise Figure Meter HP-340B to provide the input current requirements of the noise source

F. Calibrate Noise Figure Meter HP-340B.

G. Place Noise Figure Meter HP-340B front panel control to noise figure position and record noise figure in db.

H. Rotate Receiver SR-212 tuning control across the frequency band. Repeat the above measurements and adjustments for each desired frequency of noise figure measurement. Record all measurements.

I. This completes the measurements of the noise figure of the receiver. Remove all test equipment and connect all interconnecting cables to converter, CV-203

19. Input Amplifier, IA-102.

A. Normal Operating Voltages: Table 5-13, below, is a tabulation of the dc voltages normally encountered on the elements of transistors of Input Amplifier, IA-102. All voltages are measured with reference to chassis ground using an RCA Senior Voltohmyst Model WV-98C. Throughout the measurements the front panel controls were in the following positions:

TUNING RANGE MC	30-100
Tuning Control	30 mc
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for normal presentation on the signal display unit.

Transistor Symbol Number	Emitter	Base	Collector
Q1	-1.9	-1.2	6.4
Q2	-0.7	0	11.4
Q3	-6.8	-6.4	GND
Q4	0	0	GND

Table 5-13. IA-102 Transistor Voltages.

B. Alignment of the IA-102 Input Amplifier:

(1) Connect the test equipment to the receiver in the manner

indicated in Figure 5-27. Energize the test equipment and allow a warm-up time as indicated by the test equipment manufacturer's specifications.

(2) Position the front panel controls of Receiver SR-212 in the positions of paragraph A, above.

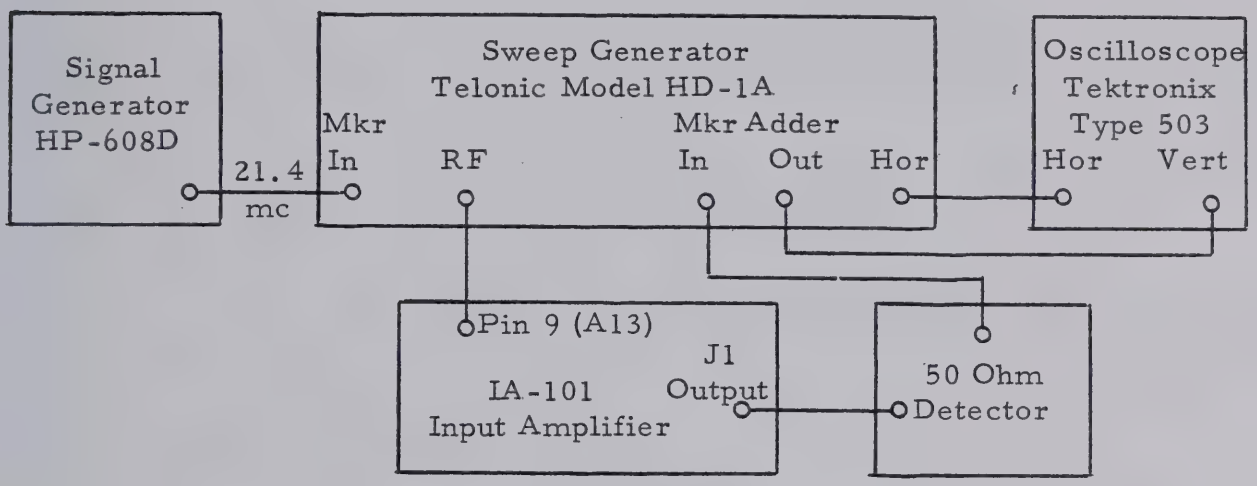


Figure 5-28. Test Setup for IA-102 Input Amplifier Alignment.

(3) Energize Receiver SR-212 by placing the POWER switch in the ON position.

(4) Adjust horizontal gain of Oscilloscope Tektronix 503 for full scale deflection of the horizontal sweep.

(5) Adjust the vertical amplifier of Oscilloscope Tektronix 503 for 2 mv per centimeter of deflection.

(6) Adjust the output of Signal Generator HP-608D for 21.4 mc. A frequency counter, the zero beat technique or some other accurate method should be used to set this output frequency.

(7) Adjust the output level of the signal generator and the marker gain controls on the sweep generator as required to achieve a small "birdie" on the scope. Adjust the frequency of the sweep generator to 21.4 mcs as indicated by the presence of the "birdie" in the center of the scope trace.

(8) Adjust the output level of the sweep generator as required to achieve a small deflection on the scope. Adjust L1 through L4 to achieve maximum symmetrical response centered around the 21.4 mc marker. Reduce the output level of the sweep generator as required to maintain the p-p response on the scope at approximately 6 mv or less.

(9) Vary the marker generator from peak-to-peak on the resulting response and measure and note that the peak-to-peak bandwidth should be approximately 3 mcs.

20. IF Amplifier & Sweep Oscillator, IFS-101.

A. Normal Operating Voltages: Table 5-14, below, is a tabulation of the dc voltages normally encountered on the elements of transistors of the IF amplifier and sweep oscillator. All voltages are measured with reference to chassis ground using an RCA Senior Voltohmyst Model WV-98C. Throughout the measurements the front panel controls were in the following positions:

TUNING RANGE MC	30-100
Tuning Control	30 mc
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range

MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for normal presentation on the signal display unit.

Transistor Symbol Number	Emitter	Base	Collector
Q1	-1.2	-0.44	-0.69
Q2	-0.69	GND	6.0
Q3	-1.8	-1.3	6.3
Q4	-0.67	GND	8.9
Q5	-8.3	-7.6	-0.02
Q6	7.5	5.2	10.5
Q7	-0.73	GND	11.7
Q8	5.2	5.7	11.8
Q9	11.4	10.9	4.9
Q10	4.9	B1=10.8	B2=GND
Q11	4.2	4.9	11.8
Q12	3.0	3.7	9.1
Q13	2.0	2.7	68.0
Q14	2.0	2.7	68

Table 5-14. IFS-101 Transistor Voltages.

B. 4.3 Mc and 455 Kc IF Alignment:

(1) Set SWEEP WIDTH and GAIN control adjustments of the signal display unit to their maximum clockwise positions.

(2) Disconnect cable from INPUT jack J2. Disconnect jumper between J5 and J6. The sweep oscillator circuits should not be connected to the base of transistor Q1 during the IF alignment.

(3) Energize Receiver SR-212 by placing the power switch in the ON position.

(4) Connect a Signal Generator HP-606A to TP4. Adjust the frequency of the signal generator to 455 kc. Adjust the output level of the signal generator for a half-scale presentation of the 455 kc input signal on the signal display unit.

(5) Adjust T1 for a maximum amplitude indication of the displayed unit.

(6) Remove Signal Generator HP-606A from TP4 and connect it to TP-3. Adjust the output level of the signal generator for a half-scale presentation of the 455 kc signal of the signal display unit.

(7) Adjust L5 for a maximum amplitude indication of the displayed signal.

(8) Remove Signal Generator HP-606A from TP3 and connect it to TP2. Adjust the frequency of the signal generator to 4.3 mcs. Adjust the output level of the signal for a half-scale presentation of the 4.3 mcs input signal on the signal display unit.

(9) Adjust L3 and L4 for a maximum amplitude indication of the displayed signal.

(10) Remove Signal Generator HP-606A from TP2 and connect it to J2 input. Adjust the output level of the signal generator for a half-scale presentation of the 4.3 mc input signal on the signal display unit.

(11) Adjust L1 and L2 for a maximum amplitude indication of the displayed signal. Remove signal generator from J2 input.

C. Sweep Oscillator Alignment:

(1) Connect jumper cable between J5 and J6.

(2) Connect Signal Generator HP-606A to J2 input. Adjust the frequency of the signal generator to 21.4 mcs. Adjust the output level of the signal generator for a half-scale presentation of the 21.4 mc input signal on the signal display unit.

(3) Adjust inductor L7 to place the response of the 21.4 mc input signal exactly in the center of the signal display unit screen.

(4) Connect Oscilloscope Tektronix 503 between terminal 14 and ground on the IFS-101 printed circuit card. Adjust the controls of the oscilloscope as required to indicate the rate of sweep frequency.

(5) Adjust resistor R40 to achieve a sweep rate of 15 cps.

(6) Remove the oscilloscope from terminal 14 of the IFS-101 printed circuit card.

(7) Remove the signal generator from J2 input and reconnect cable to J2 input.

(8) Deenergize Receiver SR-212 by placing the POWER switch in the OFF position.

(9) Install a 500 kc crystal in the Y2 crystal holder socket located on the IA-102 printed circuit board.

(10) Energize Receiver SR-212 by placing the POWER switch in the ON position. Set MKR switch to ON.

(11) A center frequency marker, at 21.4 mc, and three sideband pips on each side of the display trace should be observed on the signal

display unit. If the marker oscillator does not function properly, adjust trigger control potentiometer R7.

(12) Adjust R46, GAIN, R59, MAX SWEEP, R42 linearity, and the horizontal positioning control for the best possible linearity of the display. Maintain the center frequency control resistor in the middle of its range at all times during these adjustments.

(13) All of the sideband pips should fall upon their respective marks on the signal display unit. Repeat steps (9) and (10) until no further improvement can be obtained.

D. Final Check:

(1) Connect a Signal Generator HP-606A to J2 input. Adjust the signal generator frequency to 21.4 mc and its output level as required to achieve full-scale deflection of the trace. Reduce the SWEEP WIDTH control as required to present the complete response.

(2) The signal displayed upon the scope should be symmetrical and show no evidence of bumps or other irregularities. If such irregularities are noted, it will be necessary to touch up the tuning of the 455 kc and the 4.3 mc inductances. Perform this adjustment while looking at the expanded signal on the trace. Adjust for both maximum gain and narrowest pulse width.

(3) This completes the alignment and test of the IFS-101 circuit board and all test equipment should be removed.

21. Other Measurements.

The SR-212 main chassis, Audio Amplifier, AA-101 and Video Amplifier, VA-202-1 have no internal adjustment provisions. Maintenance, therefore, is limited to the replacement of components for these circuits. The normal operating voltages encountered on the elements of transistors in the audio and video amplifiers, as well as the SR-212 main chassis, which includes the CRT voltages are tabulated below. All voltages were measured with an RCA Senior Voltohmyst Model WV-98C. When measuring the voltages in the following tables the controls on the front panel of the SR-212 Receiver were in the following positions:

TUNING RANGE MC	30-100
Tuning Control	30 mc
IF BANDWIDTH KC	20
FM-AM/AGC-AM/MAN-CW	AM/MAN
RF GAIN	Fully CW
VIDEO GAIN	Mid-range
AUDIO GAIN	Mid-range
MKR	OFF
BFO TUNING	Mid-range
FINE TUNING	Mid-range

The SWEEP WIDTH, CENTER FREQUENCY, and GAIN controls should be adjusted for normal presentation on the signal display unit.

Transistor Symbol Number	Emitter	Base	Collector
Q1	12.0	12.8	22.0
Q2	GND	0.68	9.6
Q3	24.5	25.0	36.0

Table 5-15. SR-212 Main Chassis Voltages.

Tube Symbol Number	Pin Voltage							
	1	2	3	4	5	6	7	8
V1	70	69	-1140	-1060	-700	66	70	-1120

Table 5-16. Cathode Ray Tube Pin Voltages.

Transistor Symbol Number	Emitter	Base	Collector
Q1	2.5	3.1	23.0
Q2	2.5	3.1	23.0
Q3	-1.4	0.16	24.0
Q4	-0.36	0.16	24.0

Table 5-17. AA-101 Transistor Voltages.

Transistor Symbol Number	Emitter	Base	Collector
Q1	-1.8	-1.2	12.0
Q2	-12.0	-11.4	-5.6
Q3	-11.4	-10.8	-4.0

Table 5-18. VA-202-1 Transistor Voltages.

22. Troubleshooting.

Table 5-19. Troubleshooting Chart.

SYMPTOM	POSSIBLE TROUBLE	REMEDY
No SDU trace, tuning dial tapes not lit, no signal strength meter indication, no video or video outputs.	Blown fuse	Check input voltage, check FUSE F1 on main chassis

Table 5-19. Troubleshooting Chart. (Cont)

SYMPTOM	POSSIBLE TROUBLE	REMEDY
Tuning dial tapes not illuminated	Defective tuning dial illuminating lamp	Check by replacing DS1, DS2, DS3, or DS4
	blown 24 volt power supply fuse	Check FUSE F2 on PS-211 Power Supply card
Less than normal deflection on signal display unit	Poor connection on CRT socket	Check and adjust connections to CRT socket
	Blown fuse on PS-211 Power Supply Card	Check FUSE F1 and F3 on PS-211 Power Supply card
Distortion in wide and narrow band video outputs	Insufficient dynamic range, see Section II, Specification data	Check AGC threshold adjustment R9, and R26, see Section V, 17, B and C.
Low Sensitivity	Defective antenna input cable	Check input cable and connection
	Insufficient receiver gain	Band A and B: Check alignment of 3 mc IF see Section V, 8 and alignment of bandwidth in operation see Section V, 9, 10 and 11. Band C and D: Check alignment of CV-203, Sec V, 12, B and C. Check alignment of bandwidth in operation Sec. V, 9, 10, and 11. Check alignment of tuners Section V, 13, 14, 15 and 16.
	High tuner noise	Band A, B and C: Check input transistor Q1 and mixer transistor Q3 Band D: Check crystal mixer CR1, see Section V, 16, D.

Table 5-19. Troubleshooting Chart. (Cont)

SYMPTOM	POSSIBLE TROUBLE	REMEDY
No signal strength meter indication	No AGC voltage	Check wiring to signal strength meter and AGC operation
Frequency tuning dial error	Mechanical gear train	See Section V, 6, gear train adjustments
Top portion of SDU trace out of focus	Defective diode	Check by replacing CR and CR2
Marker will focus horizontal trace will not	Shorted capacitor	Check by replacing C9

23. Factory Repair Facilities.

In the event that the maintenance procedures described in this section do not repair the equipment to the customers satisfaction, it may be necessary to return the equipment to the factory. This is particularly true in the adjustment of the RF tuners, where the alignment and placement of the components within the tuner is critical to the tuners operation. In this event, the experience of the manufacturer's trained personnel who originally aligned and tested the equipment are available to affect a speedy repair and return of the equipment to the customer.

When it has been determined that the equipment is to be returned, first forward a description of the trouble to the factory, whereupon instructions for correcting the trouble, authorization for equipment return, and repair time estimates may be given.

At the request of the customer instructions on our equipment are conducted. Instructions for any one equipment include the theory of operation as well as maintenance and alignment procedures.

Requests for equipment repair, or for information concerning class instruction should be forwarded to:

Astro Communication Laboratory
801 Gaither Road
Gaithersburg, Maryland, 20760
Attn: Business Manager
Tel: 301-948-5210

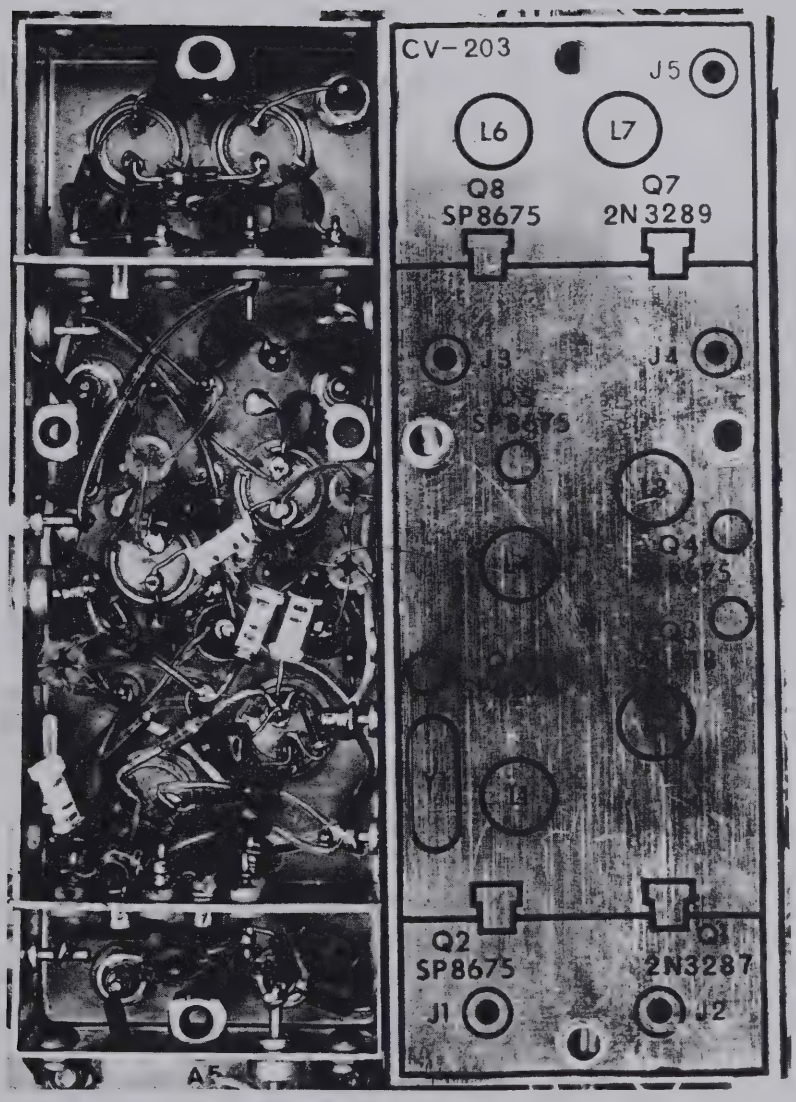


Figure 7-5A. CV-203 Converter, 60-21.4 Mc

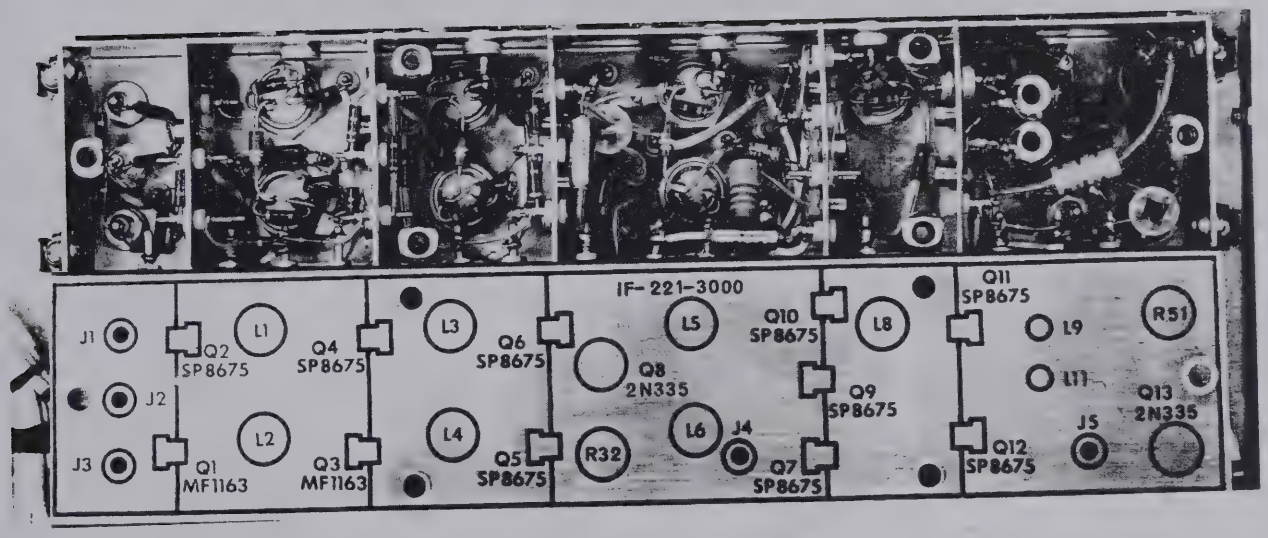
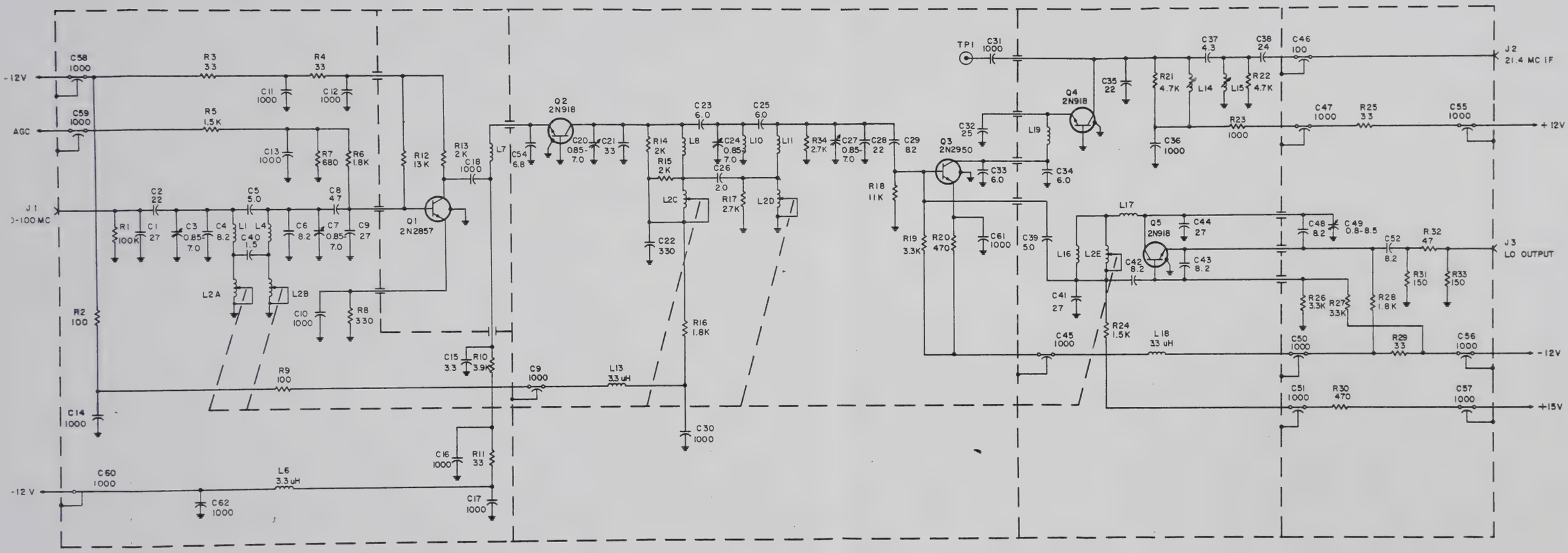


Figure 7-6A. IF-221-3000, 3 Mc Bandwidth IF Amplifier

UNLESS OTHERWISE SPECIFIED
ALL RESISTORS VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITORS VALUES ARE IN pF.



30-100 MC RF TUNING HEAD SH-211-1

Figure 7-1B. SH-211-1 Tuner, 30-100 Mc, Schematic

UNLESS OTHERWISE SPECIFIED
ALL RESISTORS VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITORS VALUES ARE IN pF.
TBD = TO BE DETERMINED

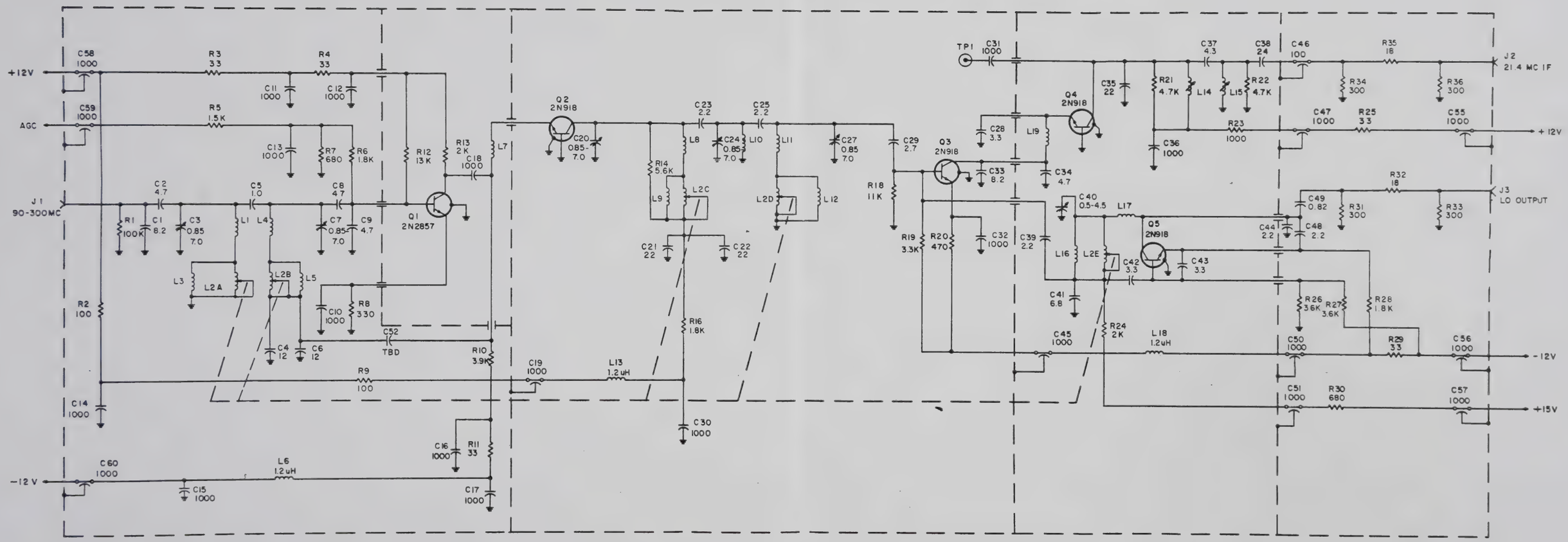


Figure 7-2B. SH-212-2 Tuner, 90-260 Mc, Schematic

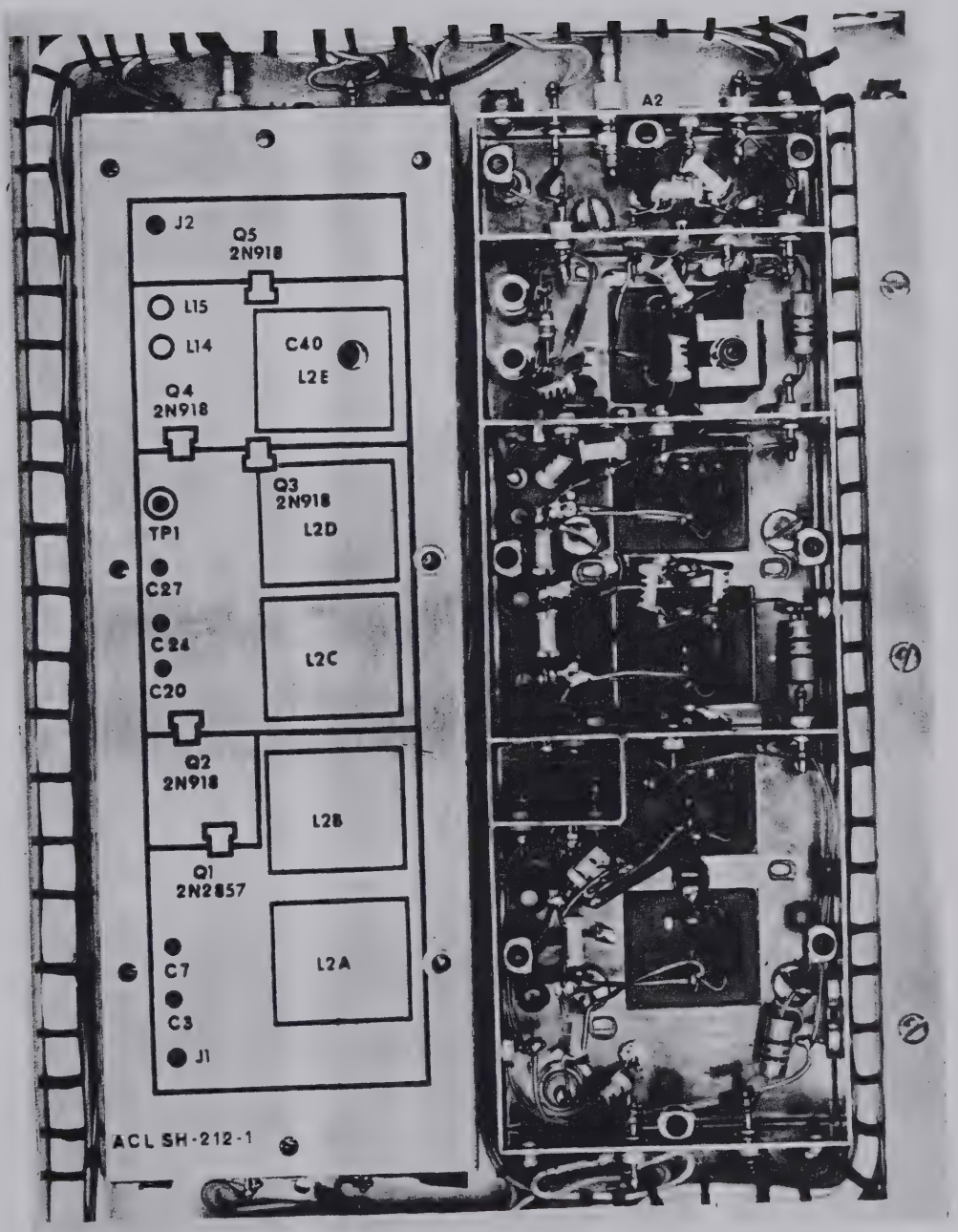


Figure 7-2A. SH-212-1 Tuner, 90-260 Mc

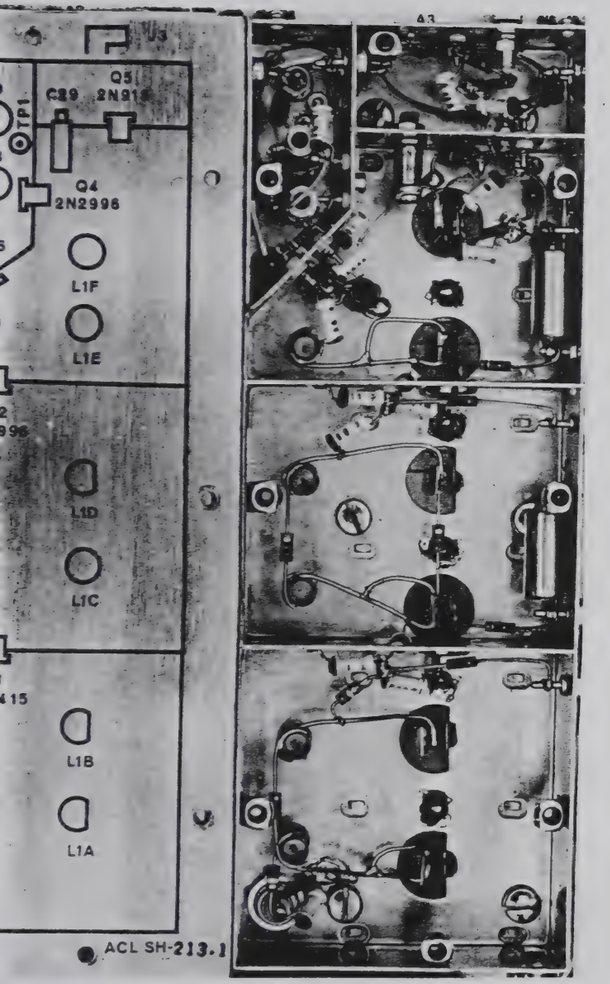
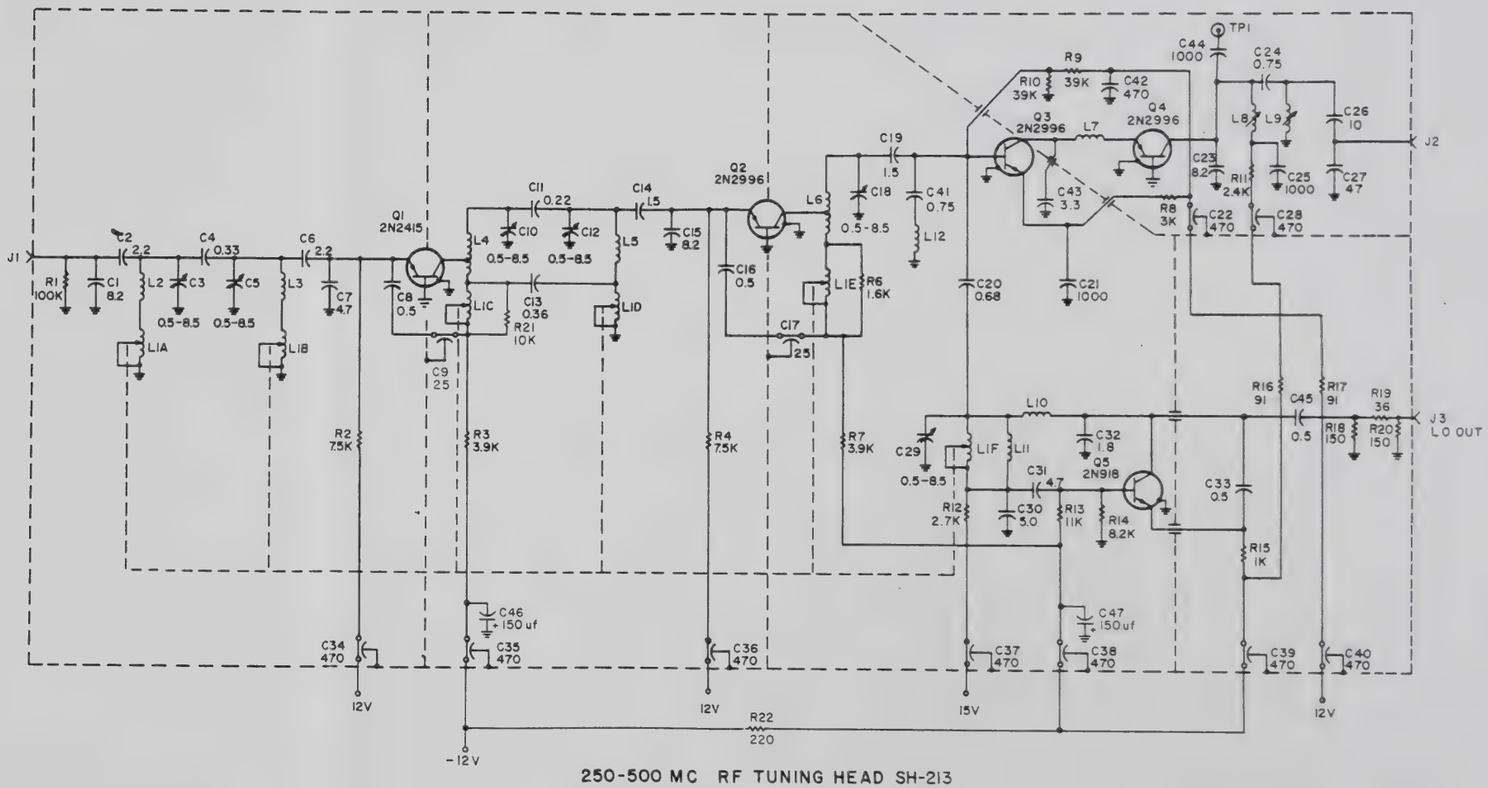


Figure 7-3A. SH-213-1 Tuner, 250-500 Mc

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITOR VALUES ARE IN pf.



250-500 MC RF TUNING HEAD SH-213

Figure 7-3B. SH-213-1 Tuner, 250-500 Mc, Schematic

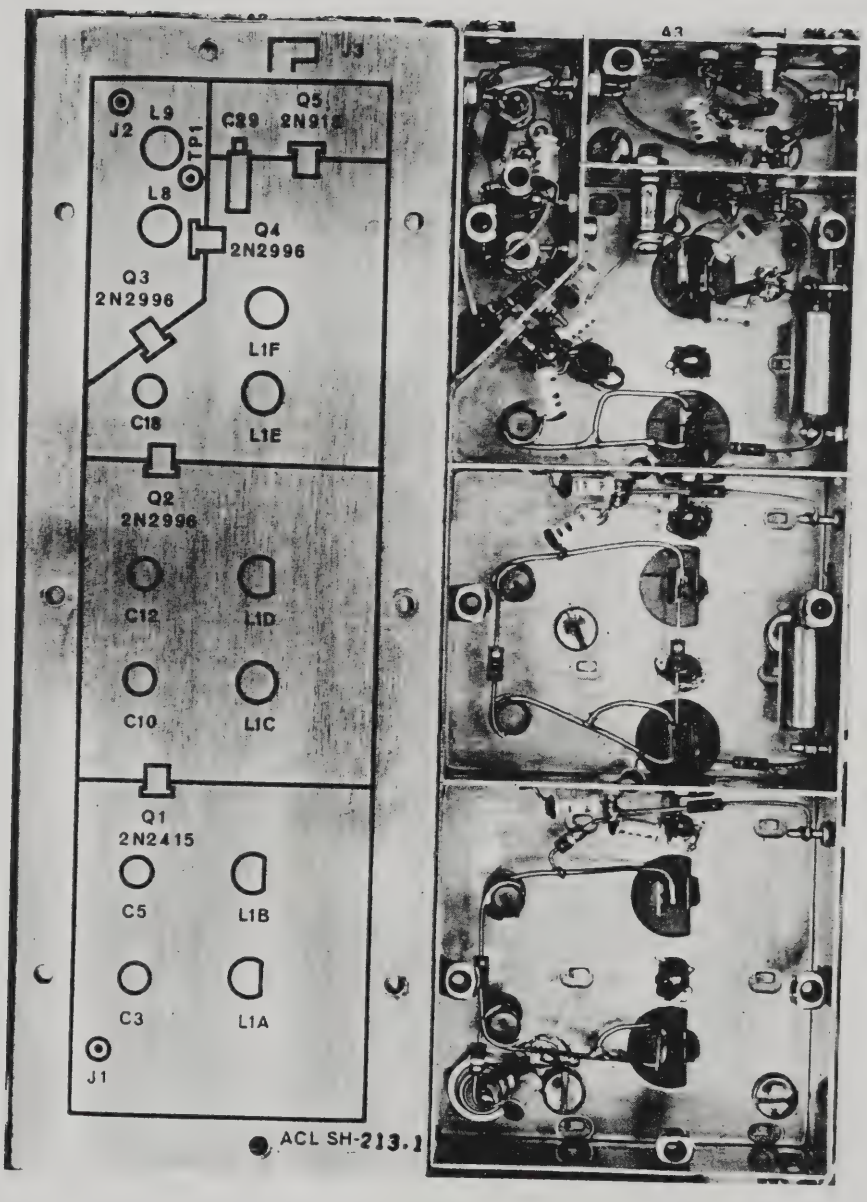


Figure 7-3A. SH-213-1 Tuner, 250-500 Mc

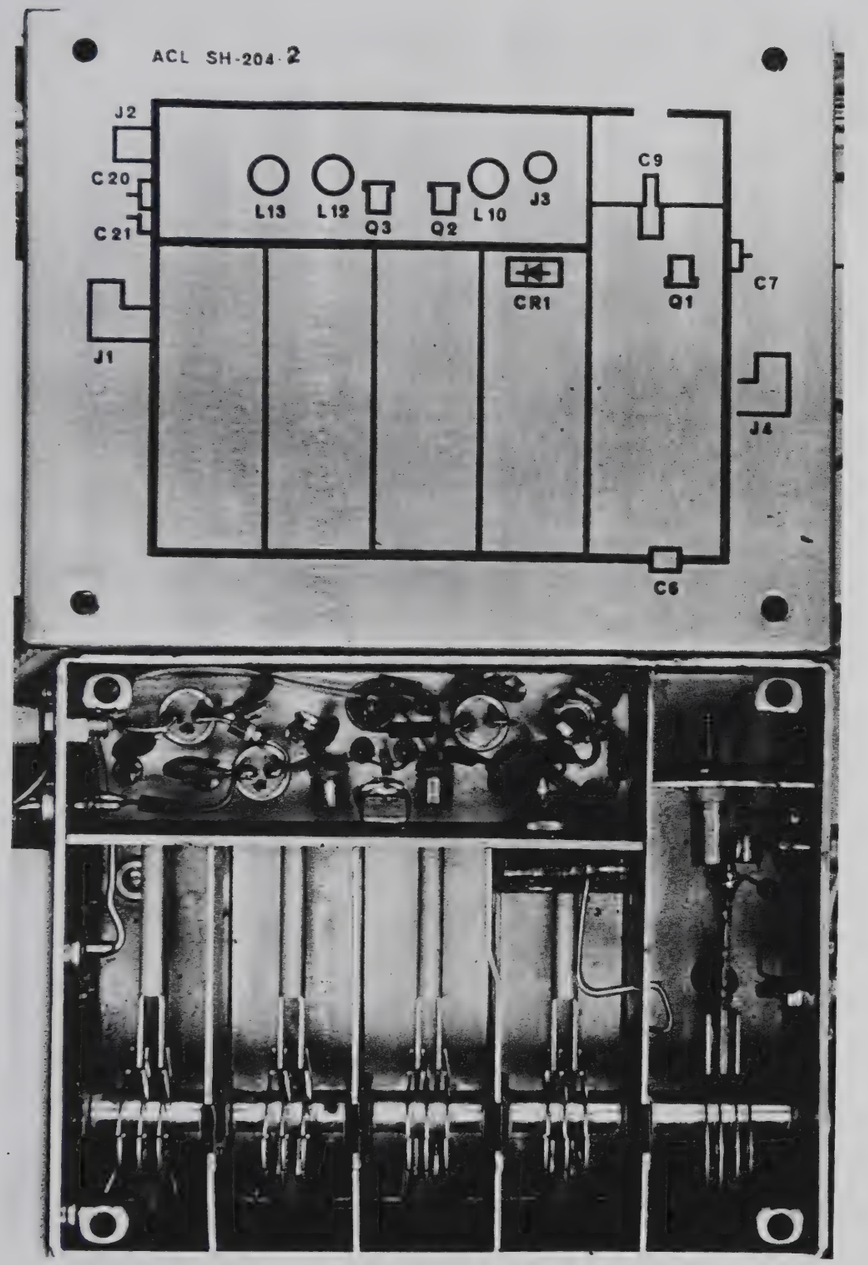
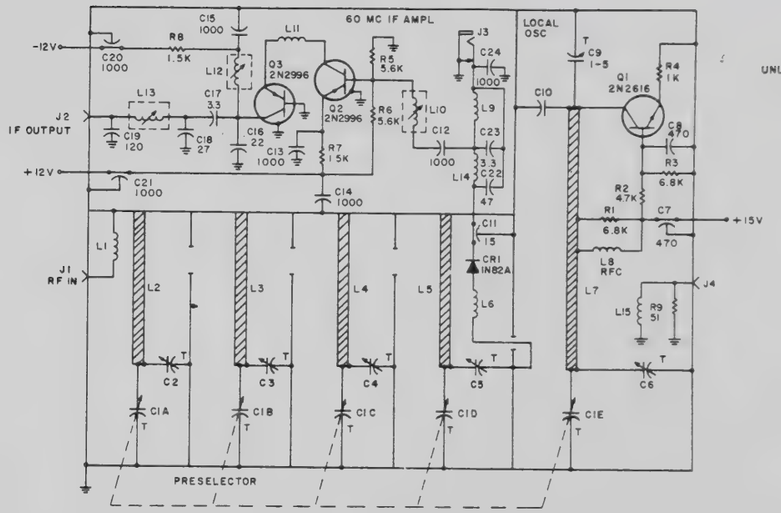


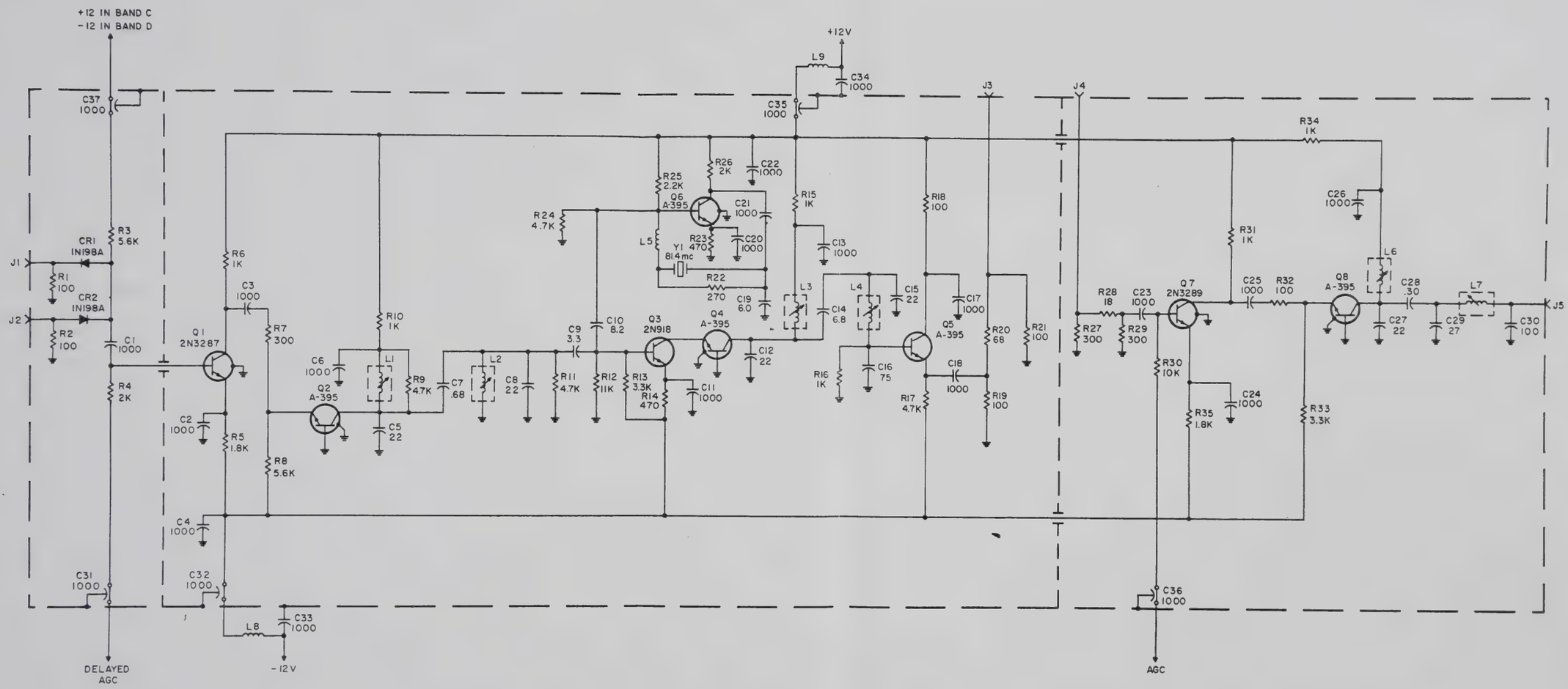
Figure 7-4A. SH-204-2 Tuner, 490-1000 Mc



UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%
ALL CAPACITOR VALUES ARE IN pf.

Figure 7-4B. SH-204-2 Tuner, 490-1000 Mc, Schematic

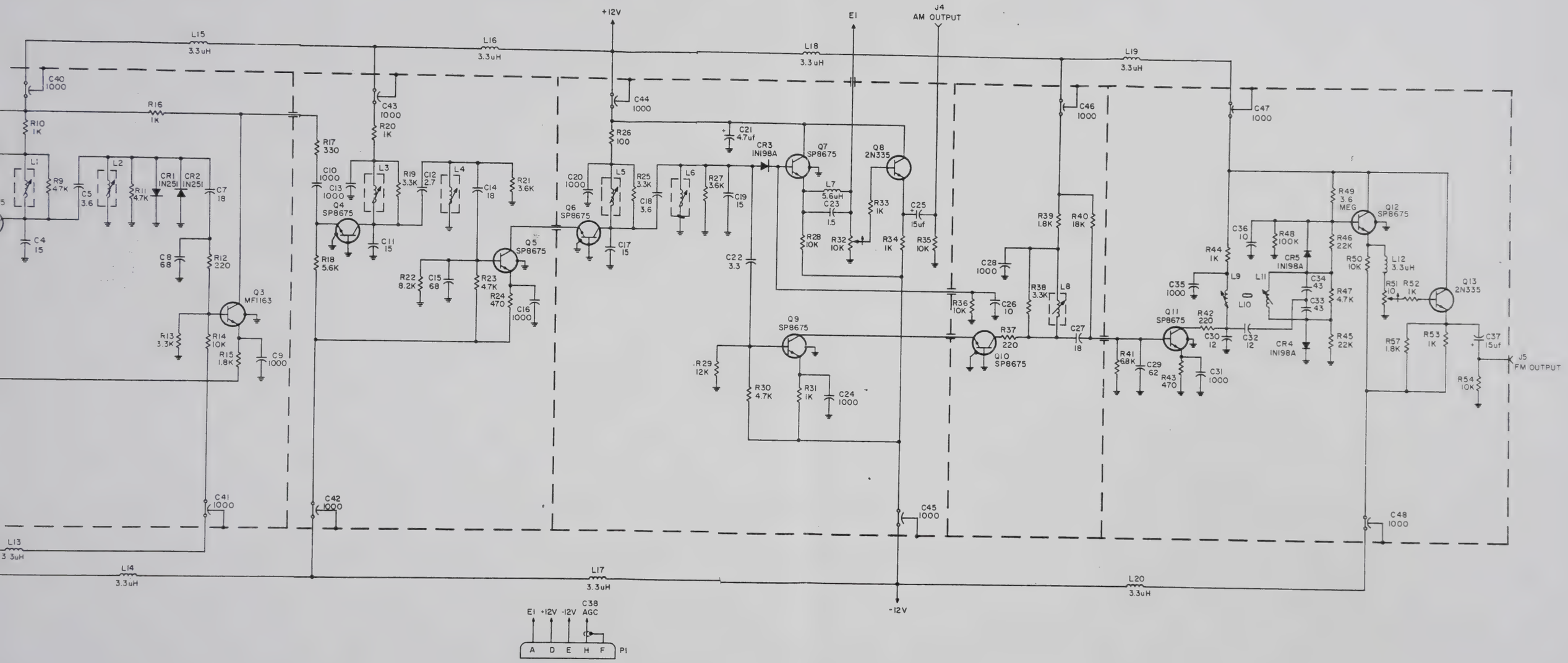
UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITORS VALUES ARE IN pF.



FREQUENCY CONVERTER CV-203

Figure 7-5B. CV-203 Converter, 60-21.4 Mc, Schematic

UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITOR VALUES ARE IN pF.



3 MC IF AMPLIFIER IF-221-3000

Figure 7-6B. IF-221-3000, 3 Mc Bandwidth IF Amplifier, Schematic

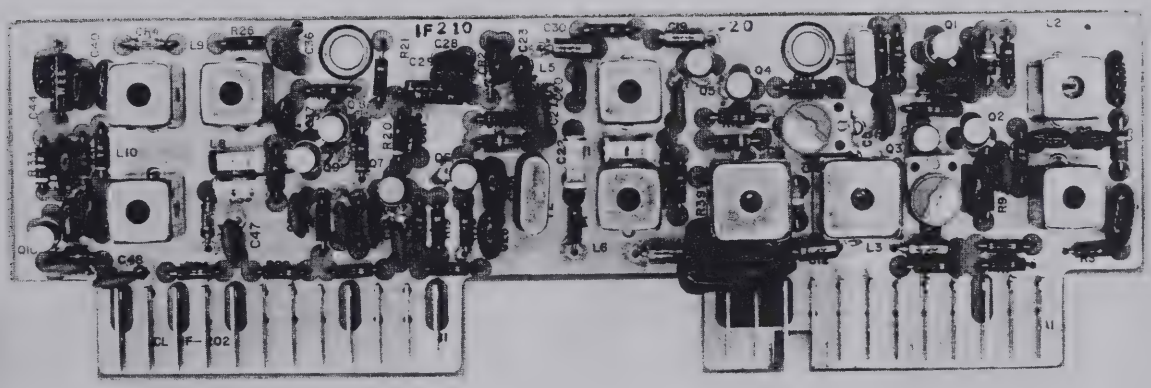


Figure 7-7A. IF-210-20, 20 Kc Bandwidth IF Amplifier

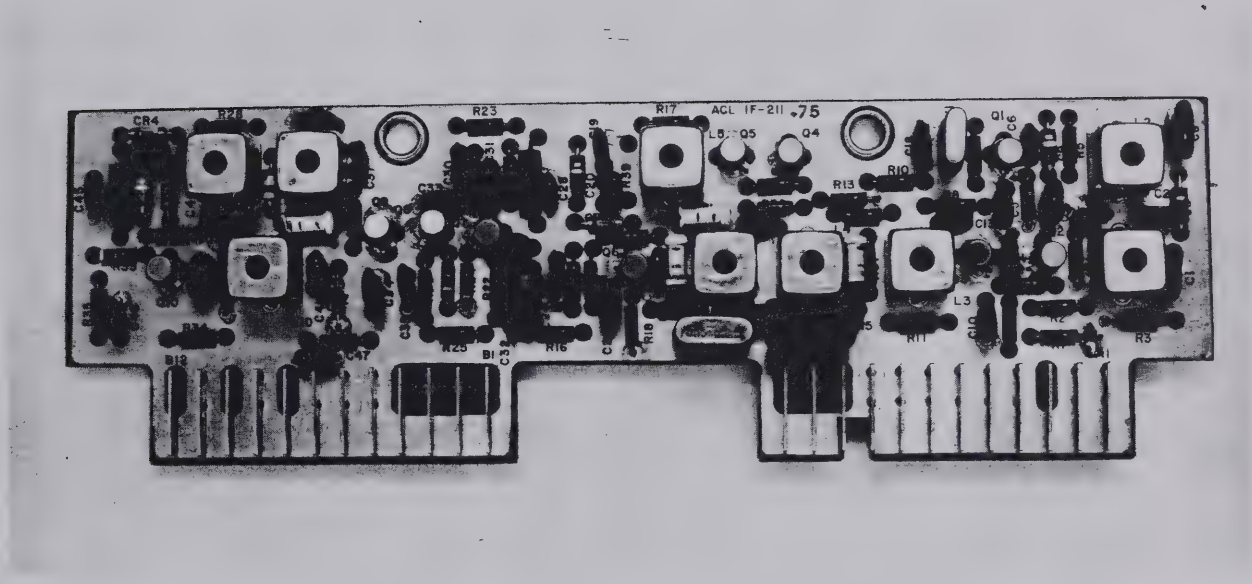
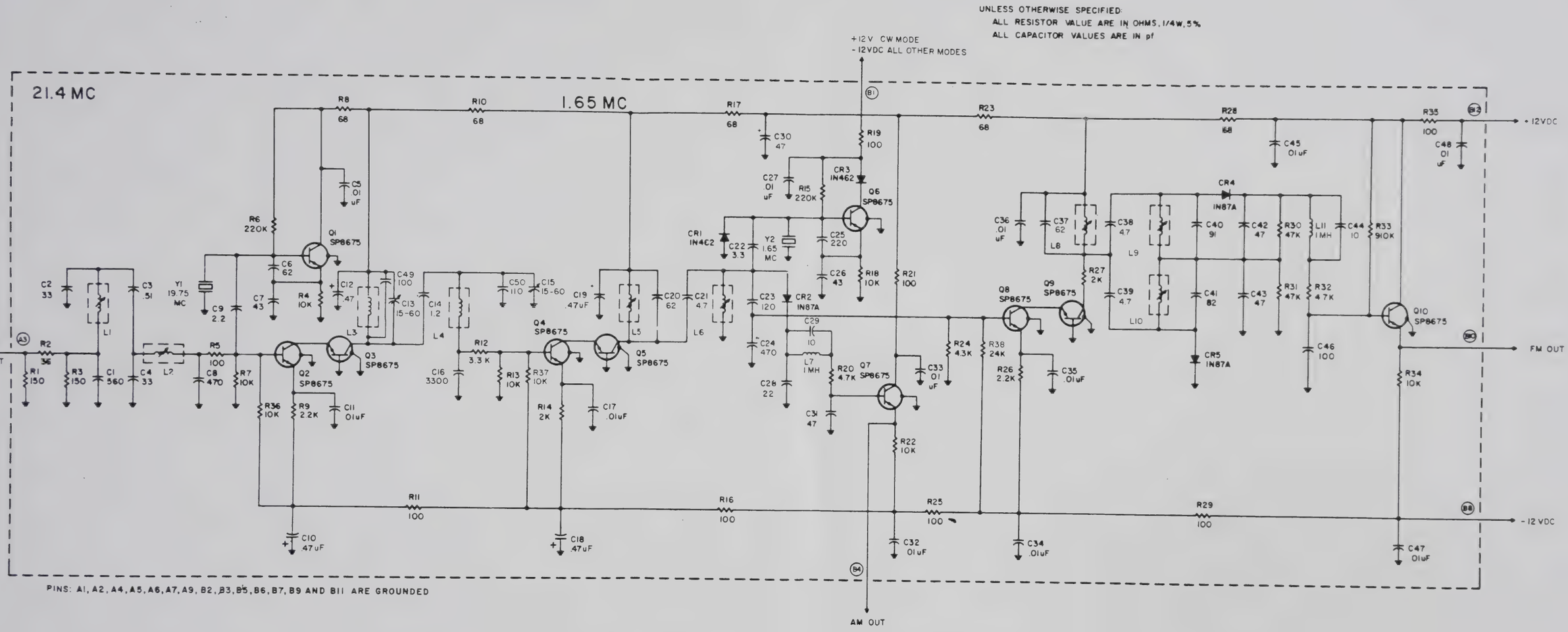
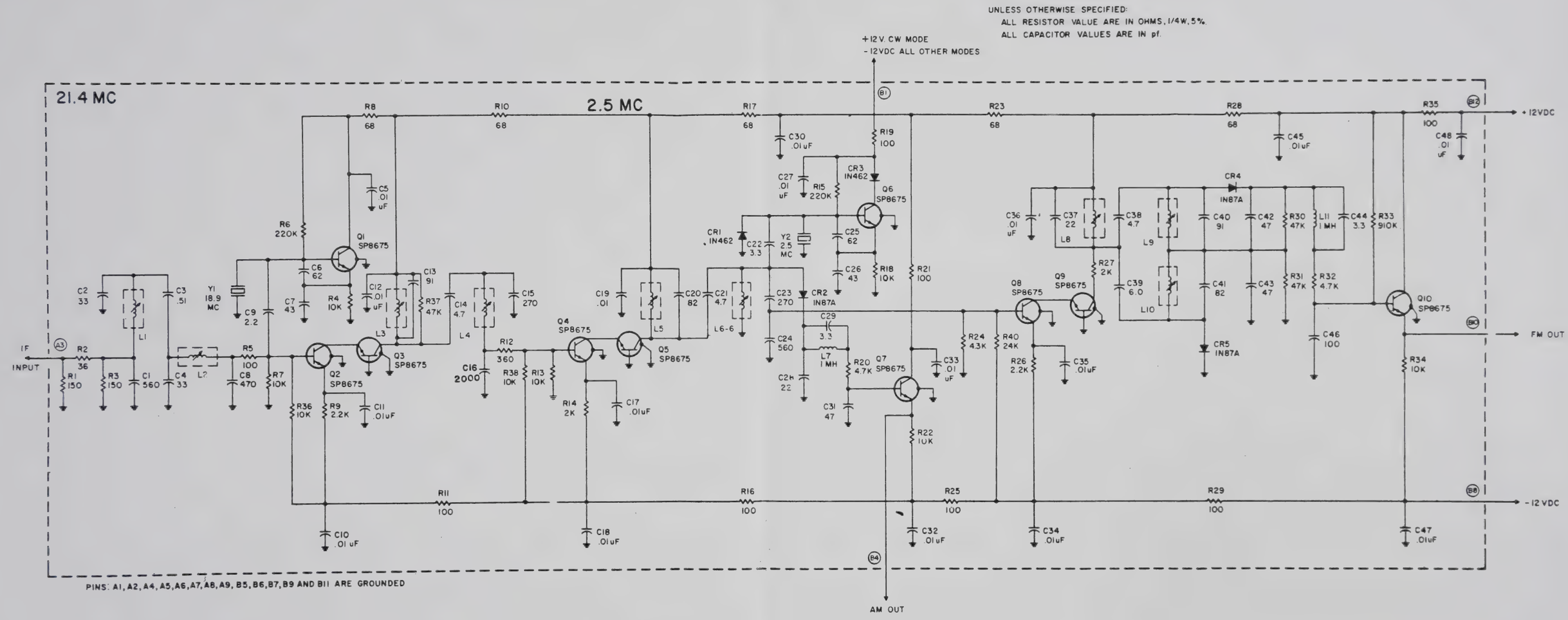


Figure 7-8A. IF-211-75, 75 Kc Bandwidth IF Amplifier



20KC BANDWIDTH IF AMPLIFIER IF-210-20

Figure 7-7B. IF-210-20, 20 Kc Bandwidth IF Amplifier, Schematic



75KC BANDWIDTH IF AMPLIFIER IF-211-75

Figure 7-8B. IF-211-75, 75 Kc Bar
IF Amplifier, Schema

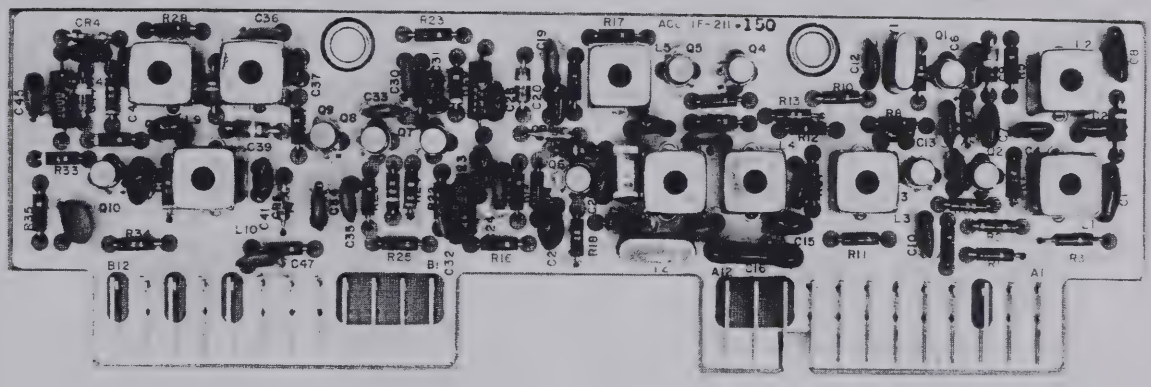


Figure 7-9A. IF-211-150, 150 KC Bandwidth IF Amplifier

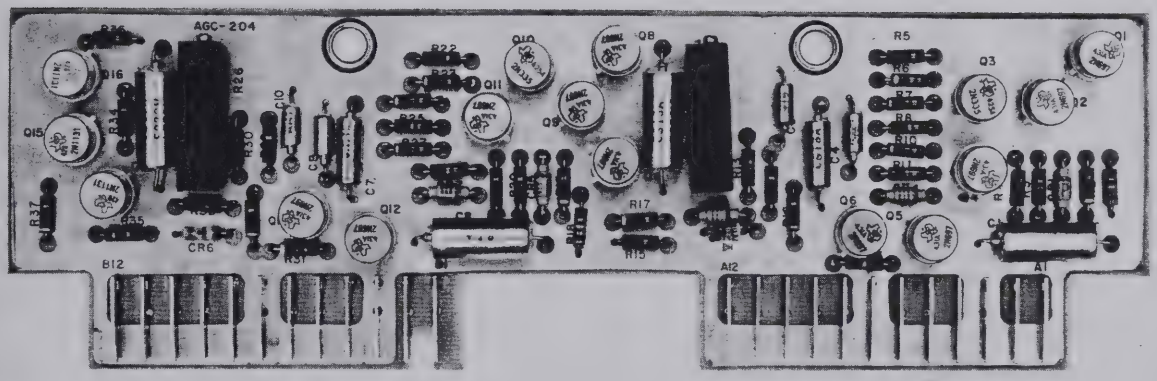
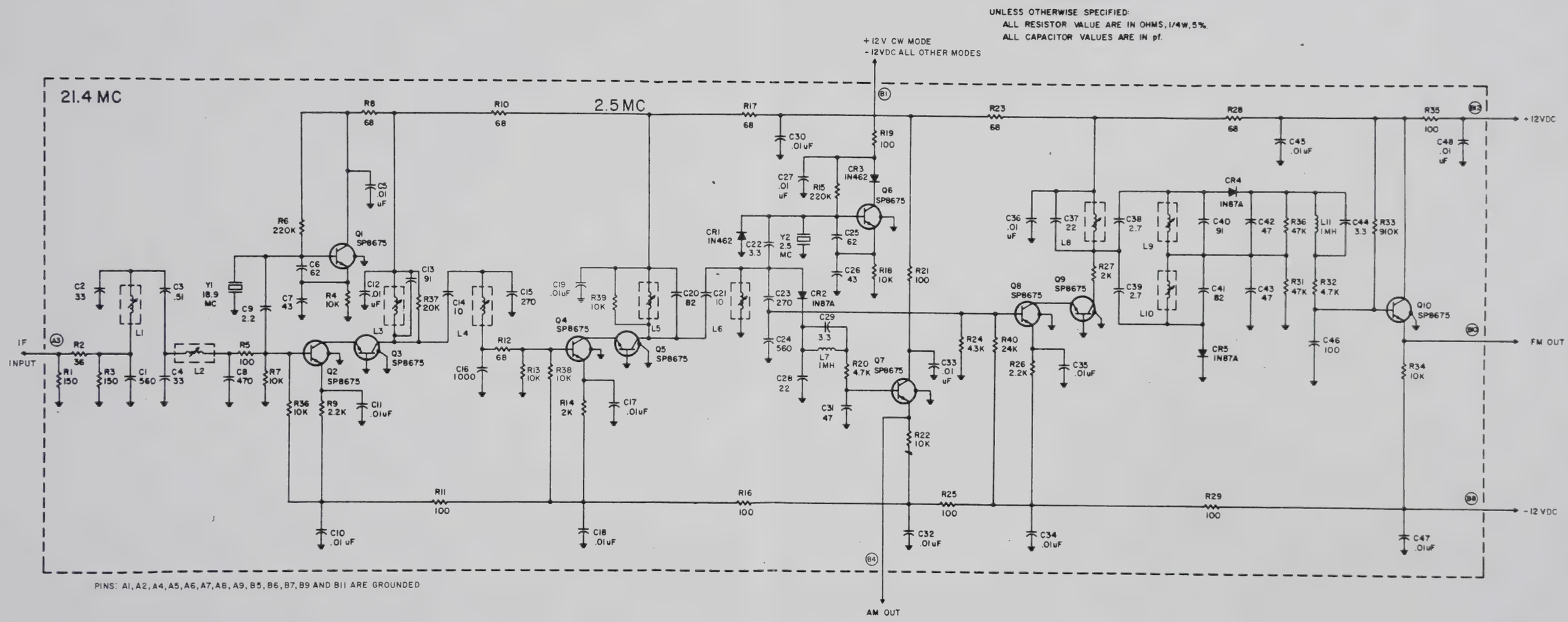


Figure 7-10A. AGC-204 AGC Amplifier


UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUE ARE IN OHMS, 1/4W, 5%.
ALL CAPACITOR VALUES ARE IN pf.
+12V CW MODE
-12VDC ALL OTHER MODES
21.4 MC
2.5 MC
IF INPUT
+12VDC
FM OUT
-12 VDC
AM OUT
PINS: A1, A2, A4, A5, A6, A7, A8, A9, B5, B6, B7, B9 AND B11 ARE GROUNDED

150KC BANDWIDTH IF AMPLIFIER IF-211-150 KC

Figure 7-9B. IF-211-150, 150 Kc Bandwidt
IF Amplifier, Schematic

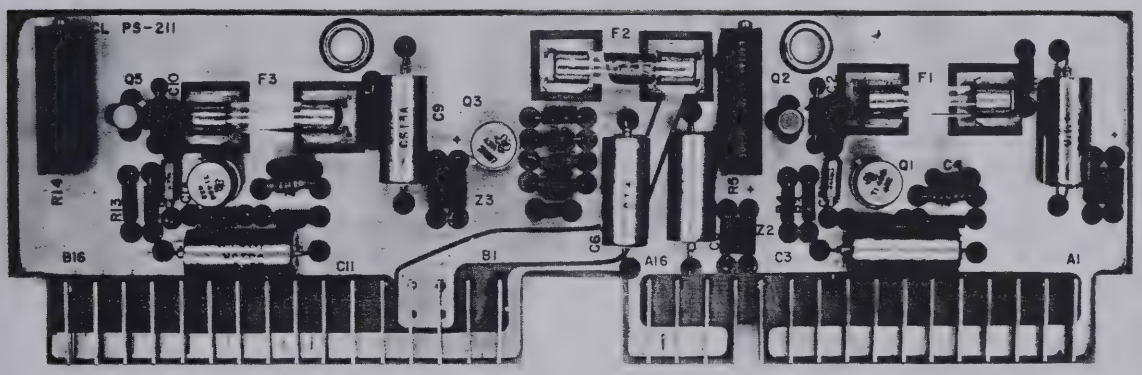
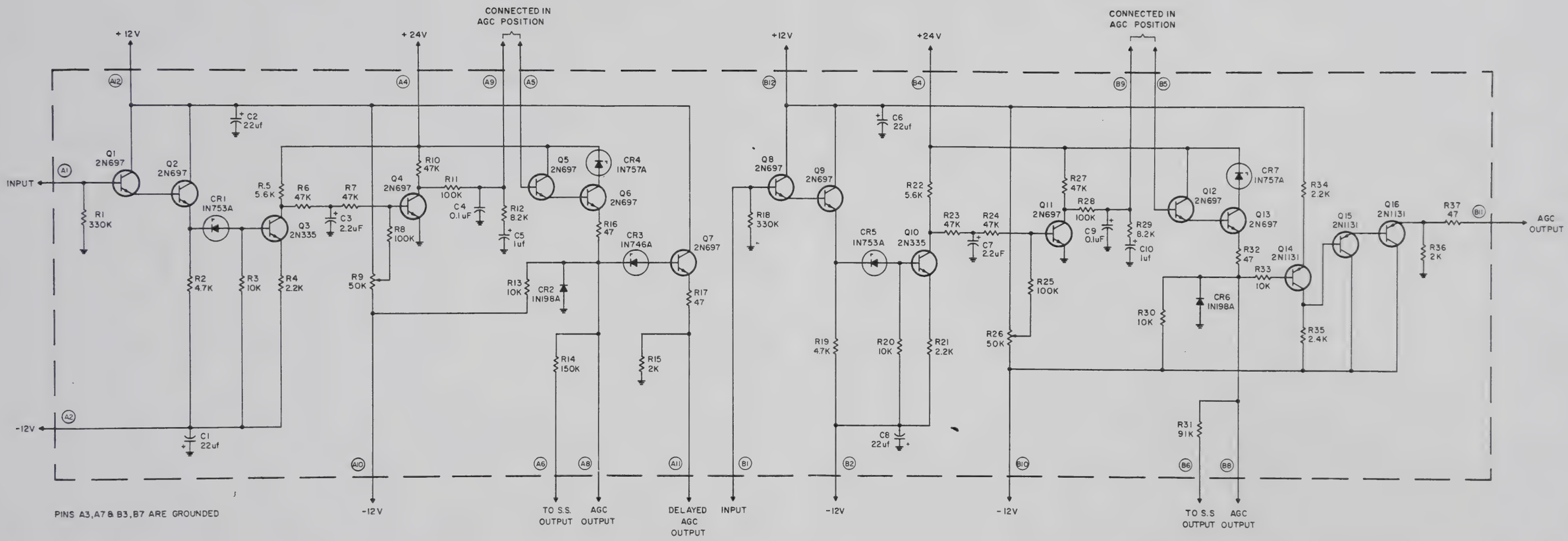


Figure 7-13A. PS-211, ±12 VDC & +24 VDC Power Supply

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 5%.
ALL CAPACITOR VALUES ARE IN pF.



AGC AMPLIFIER AGC-204

Figure 7-10B. AGC-204, AGC Amplifier, Schematic

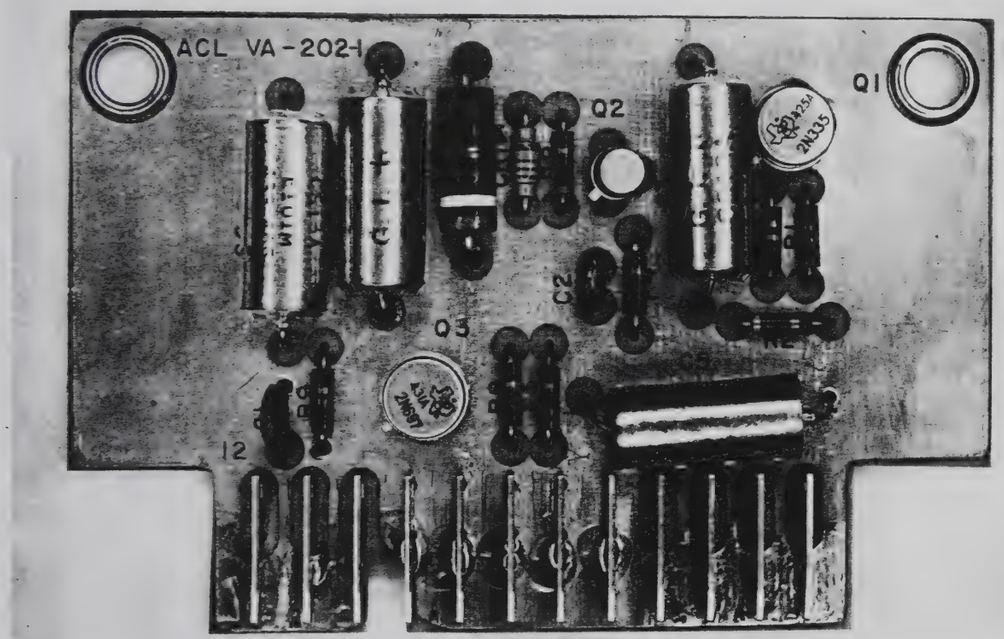
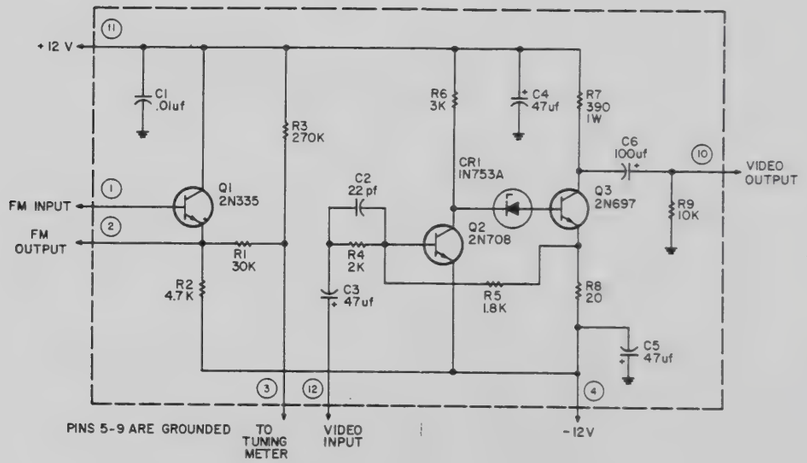


Figure 7-11A. VA-202-1, Video Amplifier

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 5%, 1/4 W



VIDEO AMPLIFIER VA-202 OR VA-202-1

Figure 7-11B. VA-202-1, Video Amplifier, Schematic

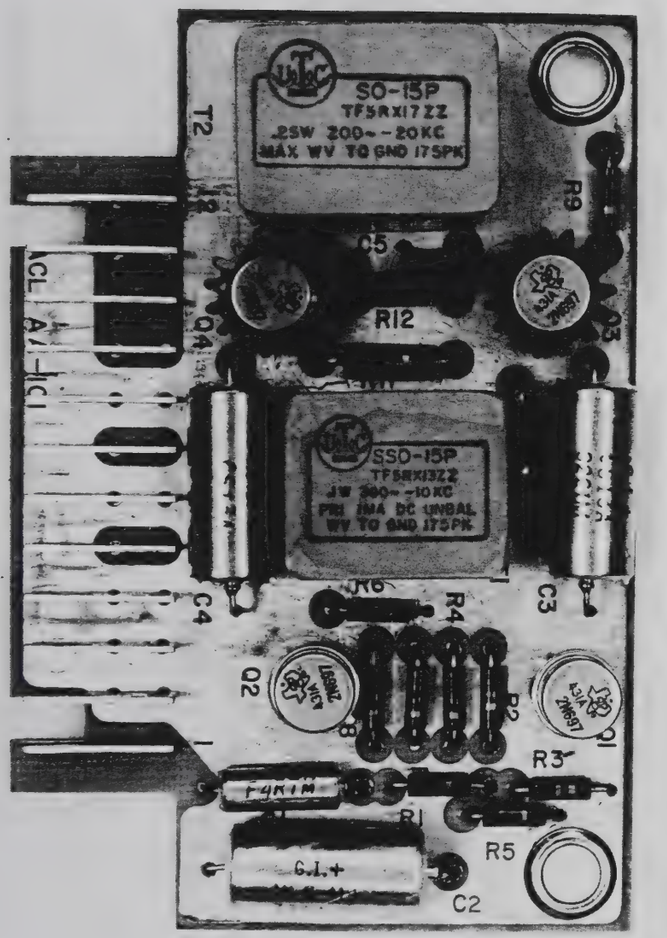
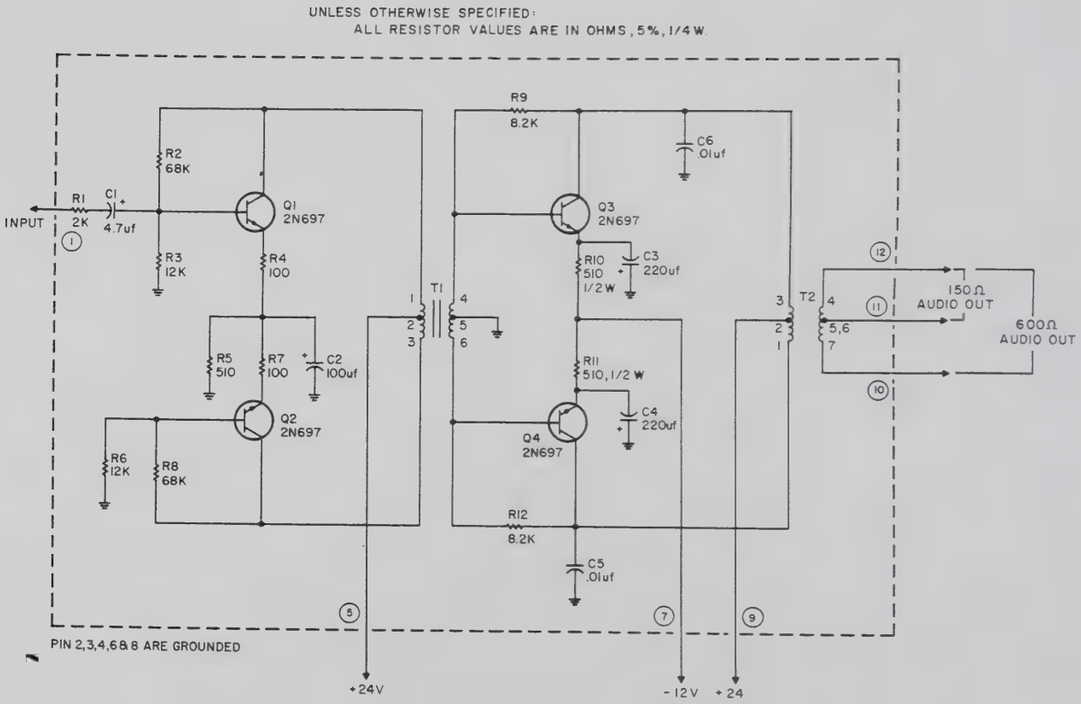


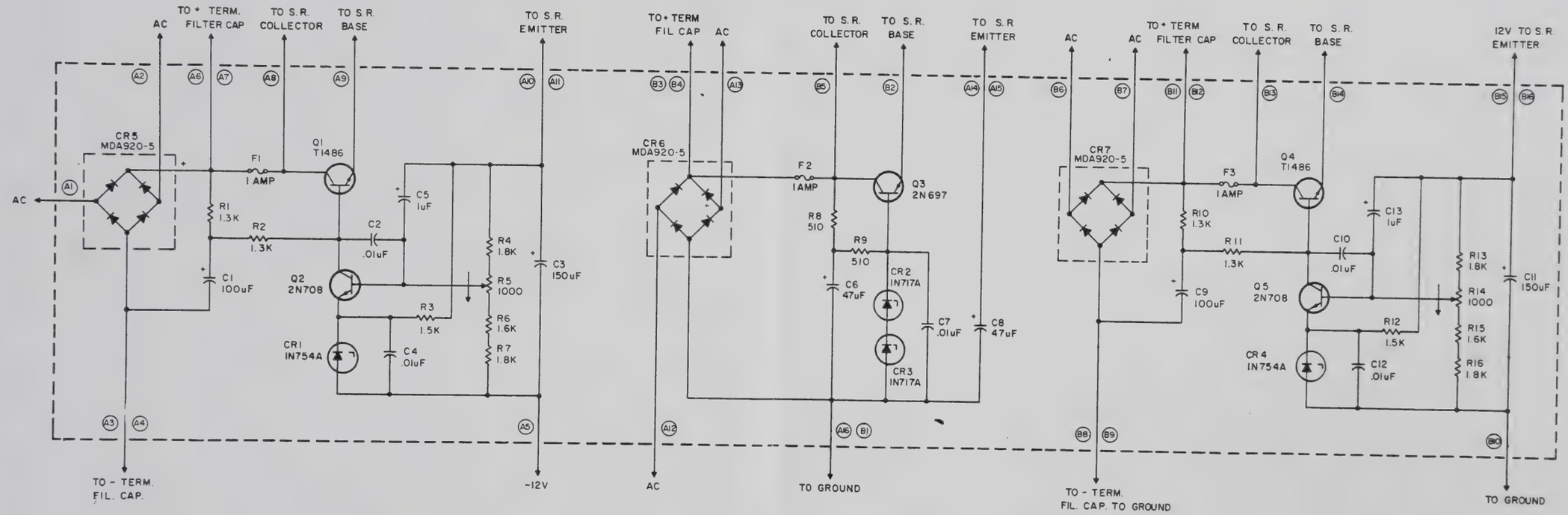
Figure 7-12A. AA-101, Audio Amplifier



AUDIO AMPLIFIER AA-101

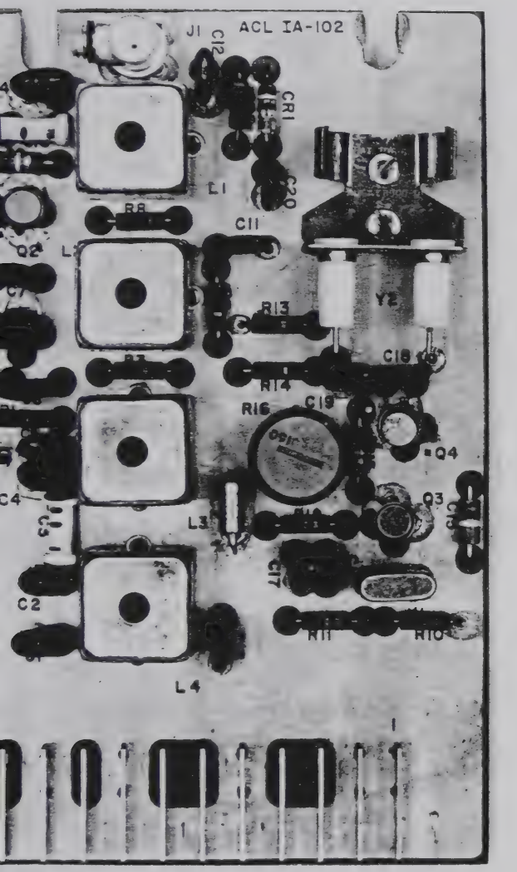
Figure 7-12B. AA-101, Audio Amplifier, Schematic

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITOR VALUES ARE IN UUF.

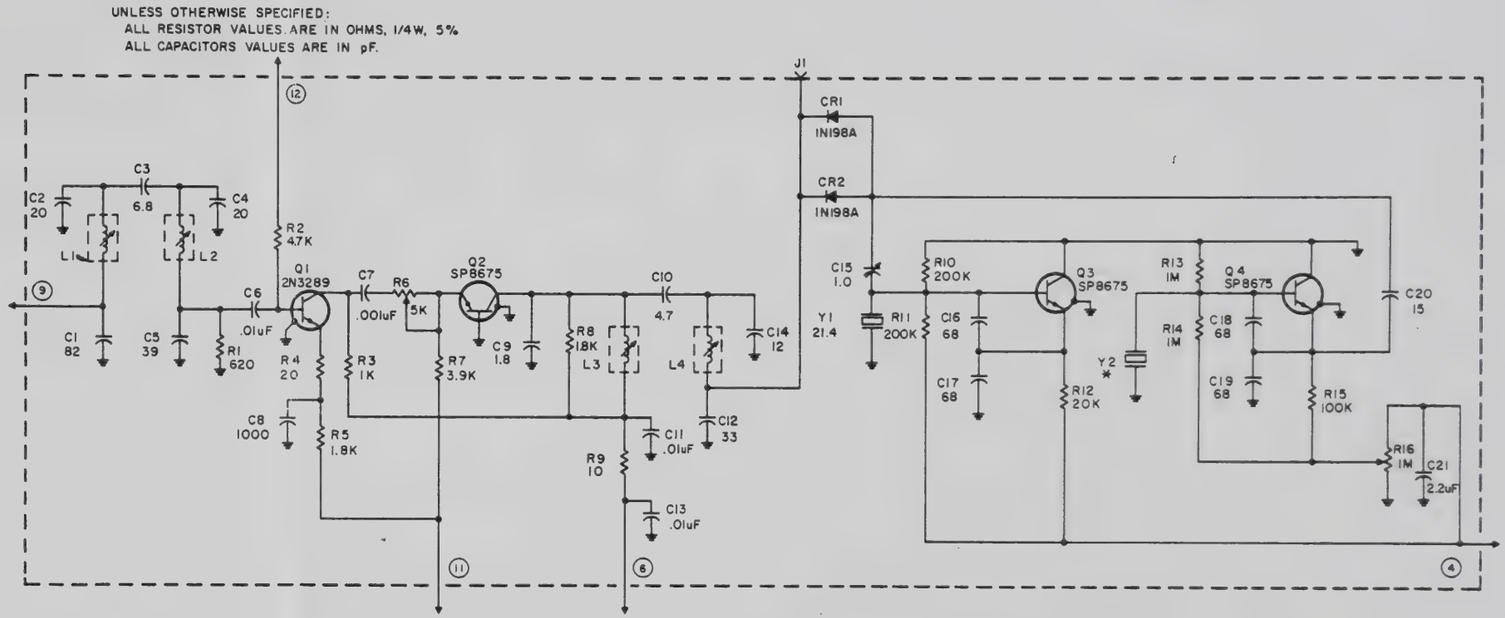


± 12 VDC & +24 VDC POWER SUPPLY PS-211

Figure 7-13B. PS-
+24
Schem



e 7-14A. IA-102, Input Amplifier



INPUT AMPLIFIER IA-102

Figure 7-14B. IA-102, Input Amplifier, Schematic

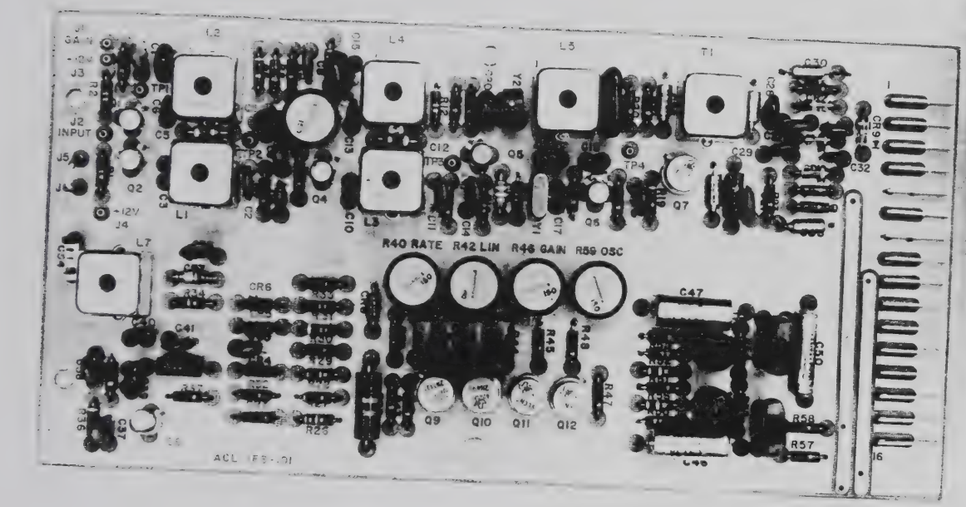


Figure 7-15A. IFS-101, IF Amplifier & Sweep Oscillator

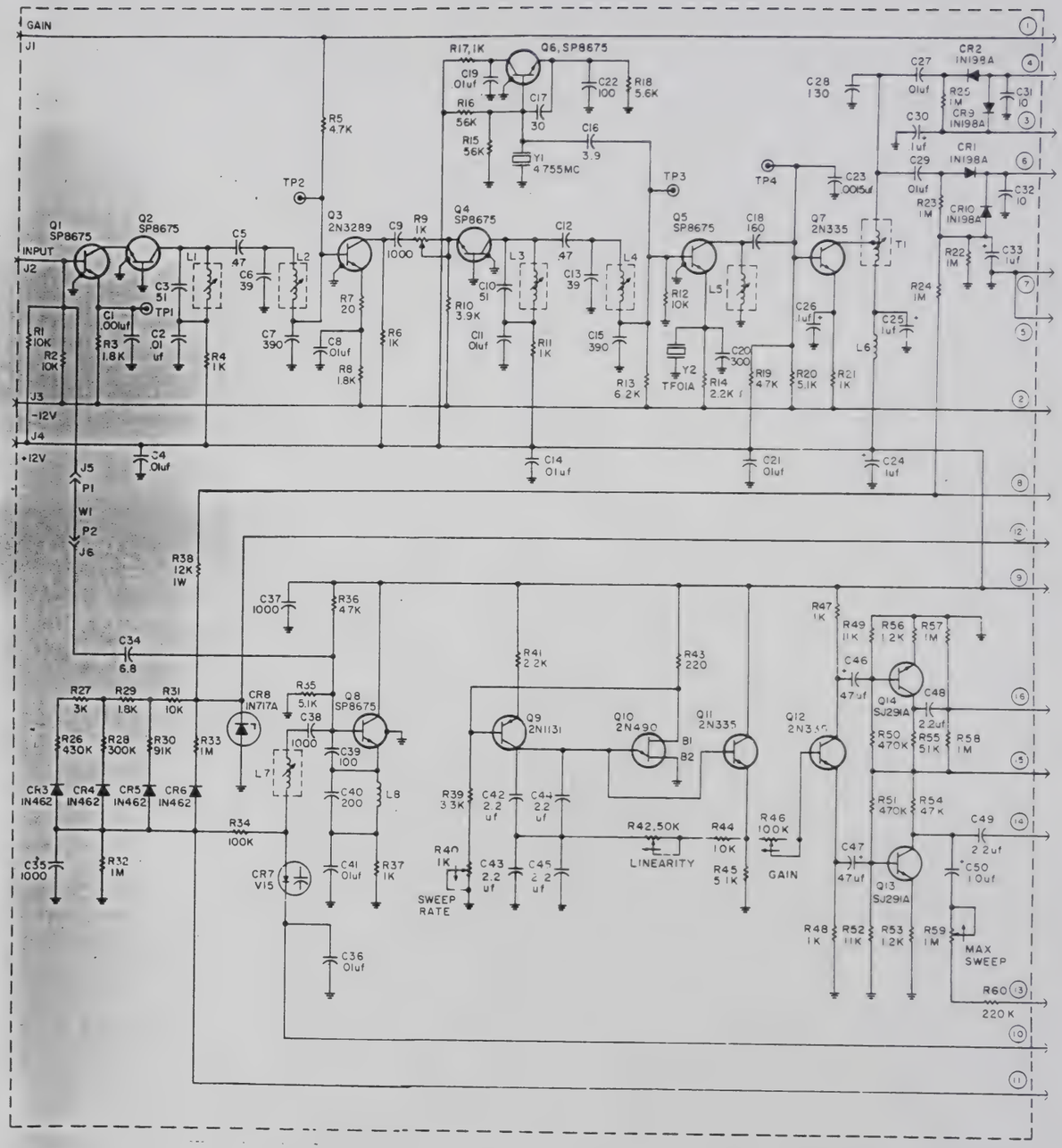
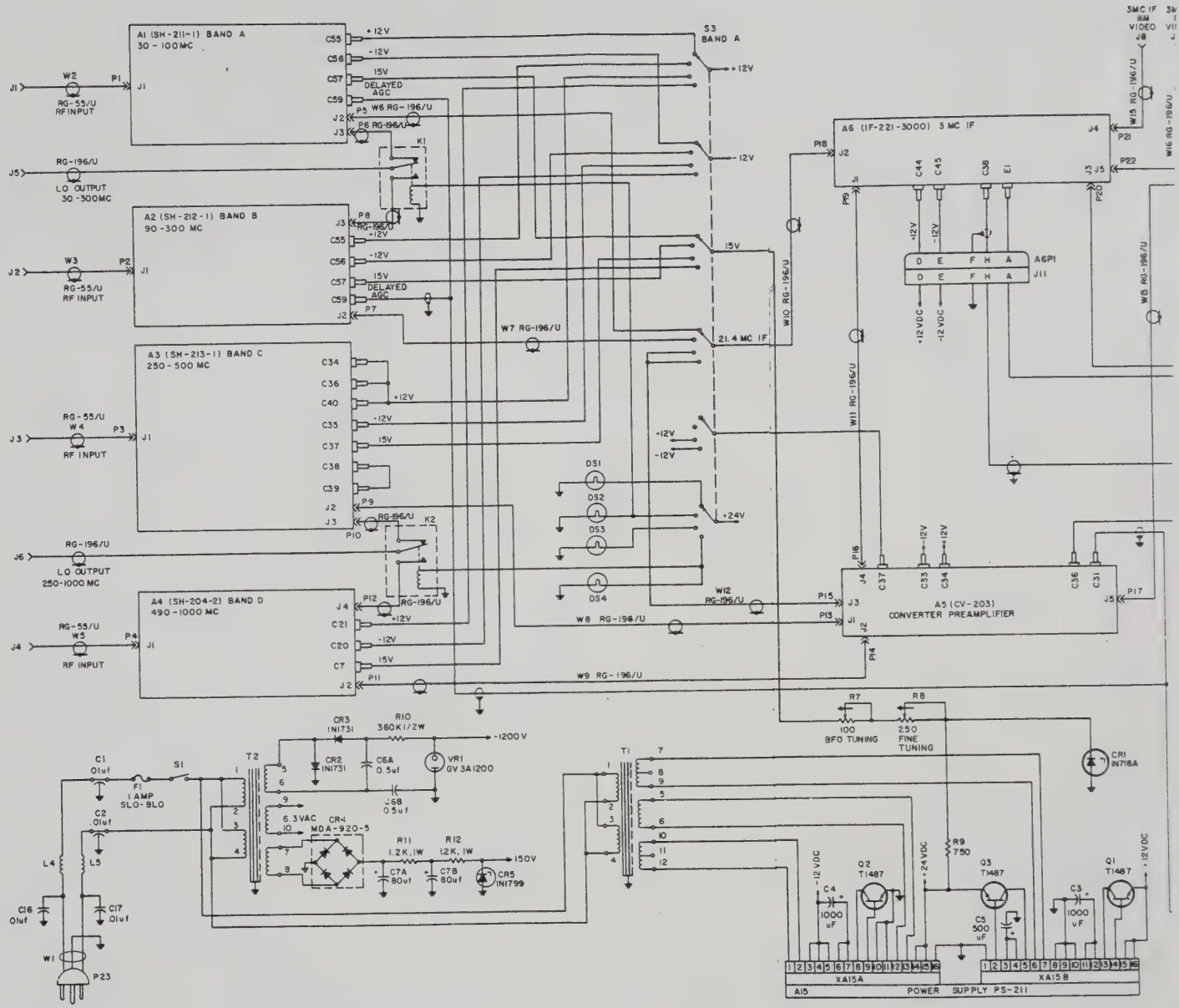


Figure 7-15B. IFS-101, IF Amplifier & Sweep Oscillator, Schematic


A1 (SH-211-1) BAND A
30 - 100 MC
A2 (SH-212-1) BAND B
90 - 300 MC
A3 (SH-213-1) BAND C
250 - 500 MC
A4 (SH-204-2) BAND D
490 - 1000 MC
A5 (CV-203)
CONVERTER PREAMPLIFIER
A6 (IF-221-3000) 3 MC IF
S3
BAND A
RG-55/U
RF INPUT
RG-196/U
LO OUTPUT
30 - 300 MC
LO OUTPUT
250-1000 MC
+12V
-12V
15V
DELAYED
AGC
21.4 MC IF
+24V
W1 RG-196/U
W2 RG-196/U
W3 RG-196/U
W4 RG-196/U
W5 RG-196/U
W6 RG-196/U
W7 RG-196/U
W8 RG-196/U
W9 RG-196/U
W10 RG-196/U
W11 RG-196/U
W12 RG-196/U
DS1
DS2
DS3
DS4
K1
K2
R7
100
BFO TUNING
R8
250
FINE
TUNING
CR1
IN718A
C1
.01uf
F1
1 AMP
SLO-BLO
S1
T2
CR3
IN1731
R10
360K 1/2W
-1200 V
CR2
IN1731
C6A
0.5uf
C6B
0.5uf
VR1
GV3A1200
6.3VAC
CR4
MDA-920-5
R11
1.2K, 1W
R12
12K, 1W
150V
C7A
80uf
C7B
80uf
CR5
IN1799
C2
.01uf
L4
L5
C16
.01uf
C17
.01uf
W1
P23
T1
-12 VDC
+24VDC
+12VDC
Q2
T1487
Q3
T1487
Q1
T1487
R9
750
C4
1000
uF
C5
500
uF
C3
1000
uF
XA15A
XA15B
A15
POWER SUPPLY PS-211

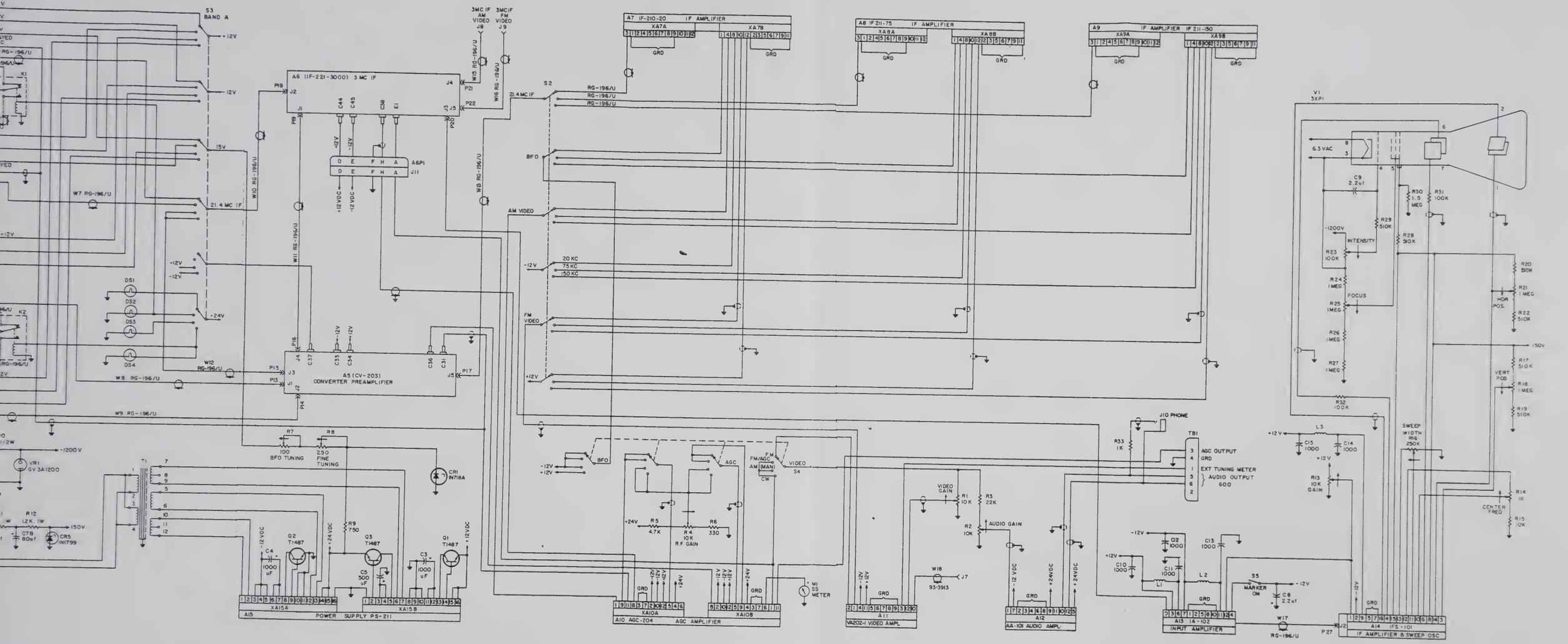


Figure 7-16. SR-212 Interconnection Diagram

IF AMPLIFIER, 3 MC, IF-221-3000

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
CR1	Semiconductor Device, Diode	Sylvania	1N251	2
CR2	Same as CR1			
CR3	Semiconductor Device, Diode	Sylvania	1N198A	3
CR4	Same as CR3			
CR5	Same as CR3			
J1	Connector, Receptacle, Electrical	FXR/RF	5116=058350	5
J2	Same as J1			
J3	Same as J1			
J4	Same as J1			
J5	Same as J1			
L1	Inductance Standard, Variable	ACL	AC-184-3	7
L2	Same as L1			
L3	Same as L1			
L4	Same as L1			
L5	Same as L1			
L6	Same as L1			
L7	Inductance Standard, Fxd 5.6 uh	CTC	2960-37-3	1
L8	Same as L1			
L9	Coil, RF	ACL	AB-002-11	1
L10	Inductance Standard, Variable	ACL	B-045-6	1
L11	Same as L9			
L12	Inductance Standard, Fxd 3.3 uh	CTC	2960-34-3	9

IF AMPLIFIER, 3 MC, IF-221-3000

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
L13	Same as L12			
L14	Same as L12			
L15	Same as L12			
L16	Same as L12			
L17	Same as L12			
L18	Same as L12			
L19	Same as L12			
L20	Same as L12			
P1	Connector, Plug, Electrical	Winchester	M7PLR19H	1
Q1	Transistor	Motorola	MF1163	2
Q2	Transistor	ACL	A-395	9
Q3	Same as Q1			
Q4	Same as Q2			
Q5	Same as Q2			
Q6	Same as Q2			
Q7	Same as Q2			
Q8	Transistor	TI	2N335	2
Q9	Same as Q2			
Q10	Same as Q2			
Q11	Same as Q2			
Q12	Same as Q2			
Q13	Same as Q8			

IF AMPLIFIER, 3 MC, IF-221-3000

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
R1	Resistor, Fxd, Composition 150 ohms ±5% 1/4W	AB	CB1515	2
R2	Resistor, Fxd, Composition 200 ohms ±5% 1/4W	AB	CB2015	1
R3	Resistor, Fxd, Composition 100 ohms ±5% 1/4W	AB	CB1015	2
R4	Resistor, Fxd, Composition 13 K ohms ±5% 1/4W	AB	CB1335	1
R5	Resistor, Fxd, Composition 220 ohms ±5% 1/4W	AB	CB2215	4
R6	Resistor, Fxd, Composition 1 K ohm ±5% 1/4W	AB	CB1025	10
R7	Resistor, Fxd, Composition 1.8 K ohms ±5% 1/4W	AB	CB1825	4
R8	Resistor, Fxd, Composition 5.6 K ohms ±5% 1/4W	AB	CB5625	2
R9	Resistor, Fxd, Composition 4.7 K ohms ±5% 1/4W	AB	CB4725	5
R10	Same as R6			
R11	Same as R9			
R12	Same as R5			
R13	Resistor, Fxd, Composition 3.3 K ohms ±5% 1/4W	AB	CB3325	4
R14	Resistor, Fxd, Composition 10 K ohms ±5% 1/4W	AB	CB1035	6
R15	Same as R7			
R16	Same as R6			
R17	Resistor, Fxd, Composition 330 ohms ±5% 1/4W	AB	CB3315	1
R18	Same as R8			
R19	Same as R13			
R20	Same as R6			
R21	Resistor, Fxd, Composition 3.6 K ohms ±5% 1/4W	AB	CB3625	2
R22	Resistor, Fxd, Composition 8.2 K ohms ±5% 1/4W	AB	CB8225	1
R23	Same as R9			
R24	Resistor, Fxd, Composition 470 ohms ±5% 1/4W	AB	CB4715	2

IF AMPLIFIER, 3 MC, IF-221-3000

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
R25	Same as R13			
R26	Same as R3			
R27	Same as R21			
R28	Same as R14			
R29	Resistor, Fxd, Composition 12 K ohms ±5% 1/4W	AB	CB1235	1
R30	Same as R9			
R31	Same as R6			
R32	Resistor, Variable 10 K ohms 1/2W	AB	RV6LAYSD103A	2
R33	Same as R6			
R34	Same as R6			
R35	Same as R14			
R36	Same as R14			
R37	Same as R5			
R38	Same as R13			
R39	Same as R7			
R40	Resistor, Fxd, Composition 18 K ohms ±5% 1/4W	AB	CB1835	1
R41	Resistor, Fxd, Composition 6.8 K ohms ±5% 1/4W	AB	CB6825	1
R42	Same as R5			
R43	Same as R24			
R44	Same as R6			
R45	Resistor, Fxd, Composition 22 K ohms ±5% 1/4W	AB	CB2235	2
R46	Same as R45			
R47	Same as R9			
R48	Resistor, Fxd, Composition 100 K ohms ±5% 1/4W	AB	CB1045	1

IF AMPLIFIER, 3 MC, IF-221-3000

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
R49	Resistor, Fxd, Composition 3.6 M ohm ±5% 1/4W	AB	CB3655	1
R50	Same as R14			
R51	Same as R32			
R52	Same as R6			
R53	Same as R6			
R54	Same as R14			
R55	Same as R1			
R56	Resistor, Fxd Composition 36 ohms ±5% 1/4W	AB	CB3605	1
R57	Same as R7			

20 KC IF AMPLIFIER, IF-210-20

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C1	Capacitor, Fixed Mica Dielectric 560 pf ±5% 500 VDCW	Elmenco	DM15-561J	1
C2	Capacitor, Fixed Mica Dielectric 33 pf ±5% 500 VDCW	Elmenco	DM10-330J	2
C3	Capacitor, Fixed Composition 0.51 pf ±10% 500 VDCW	QC	MC-0.51	1
C4	Same as C2			
C5	Capacitor, Fixed Ceramic Dielectric .01 uf ±20% 50 WVDC	Sprague	19C214	12
C6	Capacitor, Fixed Mica Dielectric 62 pf ±5% 500 VDCW	Elmenco	DM10-620J	3
C7	Capacitor, Fixed, Mica Dielectric 43 pf ±5% 500 VDCW	Elmenco	DM10-430J	2
C8	Capacitor, Fixed, Mica Dielectric 470 pf ±5% 500 VDCW	Elmenco	DM15-471J	2
C9	Capacitor, Fixed, Composition 2.2 pf ±10% 500 VDCW	QC	MC-2.2	1
C10	Capacitor, Fixed, Tantalum .47 uf ±20% 35 VDCW	Sprague	150D474X0035A2	5
C11	Same as C5			
C12	Same as C10			
C13	Capacitor, Variable, 15-60 pf	Erie	539-002-N1500	2
C14	Capacitor, Fixed, Composition 1.2 pf ±10% 500 VDCW	QC	MC 1.2	1
C15	Same as C13			
C16	Capacitor, Fixed, Mica Dielectric 3300 pf ±5% 500 VDCW	Elmenco	DM19-332J	1
C17	Same as C5			
C18	Same as C10			
C19	Same as C10			
C20	Same as C6			
C21	Capacitor, Fixed, Ceramic Dielectric NPO ±60 ppm 4.7 pf ±.25 pf	Erie	301-COH-479C	3
C22	Capacitor, Fixed, Ceramic Dielectric NPO ±120 ppm 3.3 pf ±25 pf	Erie	301-COJ-339C	1
C23	Capacitor, Fixed, Mica 120 pf ±5% 500VDCW	Elmenco	DM10-121J	1
C24	Same as C8			

20 KC IF AMPLIFIER, IF-210-20

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C25	Capacitor, Fixed, Mica Dielectric 220 pf ±5% 500 VDCW	Elmenco	DM10-221J	1
C26	Same as C7			
C27	Same as C5			
C28	Capacitor, Fixed, Mica Dielectric 22 pf ±5% 500 VDCW	Elmenco	DM10-220J	1
C29	Capacitor, Fixed, Mica Dielectric 10 pf ±5% 500 VDCW	Elmenco	DM10-100J	2
C30	Same as C10			
C31	Capacitor, Fixed, Mica Dielectric 47 pf ±5% 500 VDCW	Elmenco	DM10-470J	3
C32	Same as C5			
C33	Same as C5			
C34	Same as C5			
C35	Same as C5			
C36	Same as C5			
C37	Same as C6			
C38	Same as C21			
C39	Same as C21			
C40	Capacitor, Fixed, Mica Dielectric 91 pf ±5% 500 VDCW	Elmenco	DM10-910J	1
C41	Capacitor, Fixed, Mica Dielectric 82 pf ±5% 500 VDCW	Elmenco	DM10-820J	1
C42	Same as C31			
C43	Same as C31			
C44	Same as C29			
C45	Same as C5			
C46	Capacitor, Fixed, Mica Dielectric 100 pf ±5% 500 VDCW	Elmenco	DM10-101J	2
C47	Same as C5			
C48	Same as C5			

20 KC IF AMPLIFIER, IF-210-20

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C49	Same as C46			
C50	Capacitor, Fixed, Mica Dielectric 110 pf ±5% 500 VDC	Elmenco	DM10-111J	1
CR1	Semiconductor, Device, Diode	Sylvania	1N462	2
CR2	Semiconductor Device, Diode	Sylvania	1N87A	3
CR3	Same as CR1			
CR4	Same as CR2			
CR5	Same as CR2			
L1	Inductance Standard, Variable	ACL	C-257-2	2
L2	Same as L1			
L3	Inductance Stnadard, Fixed	ACL	AC-188-3	2
L4	Same as L3			
L5	Inductance Standard, Variable	ACL	C-257-8	5
L6	Same as L5			
L7	Inductance Standard, Fixed 1.0 mh	Nytronic	WEE-1000	2
L8	Same as L5			
L9	Same as L5			
L10	Same as L5			
L11	Same as L7			
Q1	Transistor	ACL	A-395	10
Q2	Same as Q1			

20 KC IF AMPLIFIER, IF-210-20

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
Q3	Same as Q1			
Q4	Same as Q1			
Q5	Same as Q1			
Q6	Same as Q1			
Q7	Same as Q1			
Q8	Same as Q1			
Q9	Same as Q1			
Q10	Same as Q1			
R1	Resistor, Fixed, Composition 150 ohm ±5% 1/4W	AB	CB1515	2
R2	Resistor, Fixed, Composition 36 ohm ±5% 1/4W	AB	CB3605	1
R3	Same as R1			
R4	Resistor, Fixed, Composition 10 K ohm ±5% 1/4W	AB	CB1035	8
R5	Resistor, Fixed, Composition 100 ohm ±5% 1/4W	AB	CB1015	8
R6	Resistor, Fixed, Composition 220 K ohm ±5% 1/4W	AB	CB2245	2
R7	Same as R4			
R8	Resistor, Fixed, Composition 68 ohm ±5% 1/4W	AB	CB6805	5
R9	Resistor, Fixed, Composition 2.2 K ohm ±5% 1/4W	AB	CB2225	2
R10	Same as R8			
R11	Same as R5			
R12	Resistor, Fixed, Composition 3.3 K ohm ±5% 1/4W	AB	CB3325	1
R13	Same as R4			
R14	Resistor, Fixed, Composition 2 K ohm ±5% 1/4W	AB	CB2025	2
R15	Same as R6			

20 KC IF AMPLIFIER, IF-210-20

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
R16	Same as R5			
R17	Same as R8			
R18	Same as R4			
R19	Same as R5			
R20	Resistor, Fixed, Composition 4.7 K ohms ±5% 1/4W	AB	CB4725	2
R21	Same as R5			
R22	Same as R4			
R23	Same as R8			
R24	Resistor, Fixed, Composition 4.3 K ohm ±5% 1/4W	AB	CB4325	1
R25	Same as R5			
R26	Same as R9			
R27	Same as R14			
R28	Same as R8			
R29	Same as R5			
R30	Resistor, Fixed, Composition 47 K ohm ±5% 1/4W	AB	CB4735	2
R31	Same as R30			
R32	Same as R20			
R33	Resistor, Fixed, Composition 910 K ohm ±5% 1/4W	AB	CB9145	1
R34	Same as R4			
R35	Same as R5			
R36	Same as R4			
R37	Same as R4			
R38	Resistor, Fixed, Composition 24 K ohm ±5% 1/4W	AB	CB2435	1

20 KC IF AMPLIFIER, IF-210-20

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
Y1	Crystal Unit, Quartz 19.75 mc	Peizo	CR-64/U	1
Y2	Crystal Unit, Quartz 1.65 mc	McCoy	M25	1

IF Amplifier, 75 Kc
IF-211-75

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C1	Capacitor, Fixed, Mica Dielectric 560 pf, ±5%, 500 vdc	Elmenco	DM-15-561J	2
C2	Capacitor, Fixed, Mica Dielectric 33 pf, ±5%, 500 vdc	Elmenco	DM-10-330J	2
C3	Capacitor, Fixed Composition Dielectric, 0.51 pf, ±10%, 500 vdc	Q. C.	MC-0.51	1
C4	Same as C2			
C5	Capacitor, Fixed, Ceramic Dielectric 0.01 pf, +80, -20%, 50 vdc	Sprague	19C214	17
C6	Capacitor, Fixed, Mica Dielectric 62 pf, ±5%, 500 vdc	Elmenco	DM-10-620J	2
C7	Capacitor, Fixed, Mica Dielectric 43 pf, ±5%, 500 vdc	Elmenco	DM-10-430J	2
C8	Capacitor, Fixed, Mica Dielectric 470 pf, ±5%, 500 vdc	Elmenco	DM-15-471J	1
C9	Capacitor, Fixed, Composition Dielectric, 2.2 pf, ±10%, 500 vdc	Q. C.	MC-2.2	1
C10	Same as C5			
C11	Same as C5			
C12	Same as C5			
C13	Capacitor, Fixed, Mica Dielectric 91 pf, ±5%, 500 vdc	Elmenco	DM-10-910J	2
C14	Capacitor, Fixed, Ceramic Dielectric NPO ±60 ppm, 4.7 pf, ±.25 pf	Erie	301-COH-479C	2
C15	Capacitor, Fixed, Mica Dielectric 270 pf, ±5%, 500 vdc	Elmenco	DM-10-271J	2
C16	Capacitor, Fixed, Mica Dielectric 2000 pf, ±5%, 500 vdc	Elmenco	DM-19-202J	1
C17	Same as C5			
C18	Same as C5			
C19	Same as C5			
C20	Capacitor, Fixed, Mica Dielectric 82 pf, ±5%, 500 vdc	Elmenco	DM-10-820J	2
C21	Same as C14			
C22	Capacitor, Fixed, Ceramic Dielectric NPO ±120 ppm, 3.3 pf, ±.25 pf	Erie	301-COJ-339C	1
C23	Same as C15			
C24	Same as C1			

IF Amplifier, 75 Kc
IF-211-75

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C25	Same as C6			
C26	Same as C7			
C27	Same as C5			
C28	Capacitor, Fixed, Mica Dielectric 22 pf, ±5%, 500 vdc	Elmenco	DM-10-220J	2
C29	Capacitor, Fixed, Composition Dielectric, 3.3 pf, ±10%, 500 vdc	Q. C.	MC-3.3	2
C30	Same as C5			
C31	Capacitor, Fixed, Mica Dielectric 47 pf, ±5%, 500 vdc	Elmenco	DM-10-470J	3
C32	Same as C5			
C33	Same as C5			
C34	Same as C5			
C35	Same as C5			
C36	Same as C5			
C37	Same as C28			
C38	Capacitor, Fixed, Composition Dielectric 4.7 pf ± 10% 500 VDC	Q.C.	MC-4.7	1
C39	Capacitor, Fixed, Ceramic Dielectric NPO ±60 ppm, 6.0 pf, ±.25 pf	Erie	301-COH-609C	1
C40	Same as C13			
C41	Same as C20			
C42	Same as C31			
C43	Same as C31			
C44	Same as C29			
C45	Same as C5			
C46	Capacitor, Fixed, Mica Dielectric 100 pf, ±5%, 500 vdc	Elmenco	DM-10-101J	1
C47	Same as C5			
C48	Same as C5			

IF Amplifier, 75 Kc
IF-211-75

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
CR1	Semiconductor Device, Diode	Sylvania	1N462	2
CR2	Semiconductor Device, Diode	Sylvania	1N87A	3
CR3	Same as CR1			
CR4	Same as CR2			
CR5	Same as CR2			
L1	Inductance Standard, Variable	ACL	AC-257-2	2
L2	Same as L1			
L3	Inductance Standard, Variable	ACL	AC-257-7	4
L4	Inductance Standard, Variable	ACL	AC-257-6	2
L5	Same as L3			
L6	Same as L4			
L7	Inductance Standard, Fixed 1.0 uh	Nytronics	WEE-1000	2
L8	Inductance Standard, Variable	ACL	AC-257-8	1
L9	Same as L3			
L10	Same as L3			
L11	Same as L7			
Q1	Transistor	ACL	A-395	10
Q2	Same as Q1			
Q3	Same as Q1			
Q4	Same as Q1			
Q5	Same as Q1			
Q6	Same as Q1			

IF Amplifier, 75 Kc
IF-211-75

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
Q7	Same as Q1			
Q8	Same as Q1			
Q9	Same as Q1			
Q10	Same as Q1			
R1	Resistor, Fixed Composition 150 ohms, ±5%, 1/4 watt	AB	CB-1515	2
R2	Resistor, Fixed, Composition 36 ohms, ±5%, 1/4 watt	AB	CB-3605	1
R3	Same as R1			
R4	Resistor, Fixed, Composition 10 k ohms, ±5%, 1/4 watt	AB	CB-1035	8
R5	Resistor, Fixed, Composition 100 ohms, ±5%, 1/4 watt	AB	CB-1015	8
R6	Resistor, Fixed, Composition 220 k ohms, ±5%, 1/4 watt	AB	CB-2245	2
R7	Same as R4			
R8	Resistor, Fixed, Composition 68 ohms, ±5%, 1/4 watt	AB	CB-6805	5
R9	Resistor, Fixed, Composition 2.2 k ohms, ±5%, 1/4 watt	AB	CB-2225	2
R10	Same as R8			
R11	Same as R5			
R12	Resistor, Fxd, Composition 360 ohms ±5% 1/4W	AB	CB-3615	1
R13	Same as R4			
R14	Resistor, Fixed, Composition 2 k ohm, ±5%, 1/4 watt	AB	CB-2025	2
R15	Same as R6			
R16	Same as R5			
R17	Same as R8			
R18	Same as R4			
R19	Same as R5			

IF Amplifier, 75 Kc
IF-211-75

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
R20	Resistor, Fixed, Composition 4.7 k ohms, ±5%, 1/4 watt	AB	CB-4725	2
R21	Same as R5			
R22	Same as R4			
R23	Same as R8			
R24	Resistor, Fixed, Composition 4.3 k ohms, ±5%, 1/4 watt	AB	CB-4325	1
R25	Same as R5			
R26	Same as R9			
R27	Same as R14			
R28	Same as R8			
R29	Same as R5			
R30	Resistor, Fixed, Composition 47 k ohms, ±5%, 1/4 watt	AB	CB-4735	3
R31	Same as R30			
R32	Same as R20			
R33	Resistor, Fixed, Composition 910 k ohms, ±5%, 1/4 watt	AB	CB-9145	1
R34	Same as R4			
R35	Same as R5			
R36	Same as R4			
R37	Same as R30			
R38	Same as R4			
R39	Not Used			
R40	Resistor, Fixed, Composition 24 k ohms, ±5%, 1/4 watt	AB	CB-2435	1
Y1	Crystal Unit, Quartz, 18.9 mc	Piezo	CR64/U	1
Y2	Crystal Unit, Quartz, 2.5 mc	McCoy	M25	1

IF AMPLIFIER, 150 KC
IF-211-150

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C1	Capacitor, Fixed, Mica Dielectric 560 pf ±5% 500 VDC W	Elmenco	DM15-561J	2
C2	Capacitor, Fixed, Mica Dielectric 33 pf ±5% 500 VDC W	Elmenco	DM10-330J	2
C3	Capacitor, Fixed, Composition (Tubular) 0.51 pf ±10% 500 VDC W	Q.C.	MC-0.51	1
C4	Same as C2			
C5	Capacitor, Fixed, Ceramic Dkelectric 0.01 pf ±20% 50 VDC	Sprague	19C214	17
C6	Capacitor, Fixed, Mica Dielectric 62 pf ±5% 500 VDC W	Elmenco	DM10-620J	2
C7	Capacitor, Fixed, Mica Dielectric 43 pf ±5% 500 VDC W	Elmenco	DM10-430J	2
C8	Capacitor, Fixed, Mica Dielectric 470 pf ±5% 500 VDC W	Elmenco	DM15-471J	1
C9	Capacitor, Fixed, Composition (Tubular) 2.2 pf ±5% 500 VDC W	Q.C.	MC-2.2	1
C10	Same as C5			
C11	Same as C5			
C12	Same as C5			
C13	Capacitor, Fixed, Mica Dielectric 91 pf ±5% 500 VDC W	Elmenco	DM10-910J	2
C14	Capacitor, Fixed, Mica Dielectric 10 pf ±5% 500 VDC W	Elmenco	DM10-100J	2
C15	Capacitor, Fixed, Mica Dielectric 270 pf ±5% 500 VDC W	Elmenco	DM10-271J	2
C16	Capacitor, Fixed, Mica Dielectric 1000 pf ±5% 500 VDC W	Elmenco	DM19-102J	1
C17	Same as C5			
C18	Same as C5			
C19	Same as C5			
C20	Capacitor, Fixed, Mica Dielectric 82 pf ±5% 500 VDC W	Elmenco	DM10-820J	2
C21	Same as C14			
C22	Capacitor, Fxd., Ceramic Die. (Tubular) NPO ±120 ppm 3.3 pf ±.25pf	Elmenco	301-COJ-339C	1
C23	Same as C15			
C24	Same as C1			

IF AMPLIFIER, 150 KC

IF-211-150

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C25	Same as C6			
C26	Same as C7			
C27	Same as C5			
C28	Capacitor, Fixed, Mica Dielectric 22 pf ±5% 500 VDC W	Elmenco	DM10-220J	2
C29	Capacitor, Fixed, Composition (Tubular) 3.3 pf ±5% 500 VDC W	Q.C.	MC-3.3	2
C30	Same as C5			
C31	Capacitor, Fixed, Mica Dielectric 47 pf ±5% 500 VDC W	Elmenco	DM10-470J	3
C32	Same as C5			
C33	Same as C5			
C34	Same as C5			
C35	Same as C5			
C36	Same as C5			
C37	Same as C28			
C38	Capacitor, Fixed, Composition(Tubular) 2.7 pf ±10% 500 VDC W	Q.C.	MC-2.7	2
C39	Same as C38			
C40	Same as C13			
C41	Same as C20			
C42	Same as C31			
C43	Same as C31			
C44	Same as C29			
C45	Same as C5			
C46	Capacitor, Fixed Mica Dielectric 100 pf ±5% 500 VDC W	Elmenco	DM10-101J	1
C47	Same as C5			
C48	Same as C5			

IF AMPLIFIER, 150 KC
IF-211-150

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
CR1	Semiconductor Device, Diode	Sylvania	IN462	2
CR2	Semiconductor Device, Diode	Sylvania	IN87A	3
CR3	Same as CR1			
CR4	Same as CR2			
CR5	Same as CR2			
L1	Inductance Standard, Variable	ACL	AC-257-2	2
L2	Same as L1			
L3	Inductance Standard, Variable	ACL	AC-257-7	4
L4	Inductance Standard, Variable	ACL	AC-257-6	2
L5	Same as L3			
L6	Same as L4			
L7	Inductance Standard, Fixed 1.0 mh	Nytronics	WEE-1000	2
L8	Inductance Standard, Variable	ACL	AC-257-8	1
L9	Same as L3			
L10	Same as L3			
L11	Same as L7			
Q1	Transistor	ACL	A-395	10
Q2	Same as Q1			
Q3	Same as Q1			
Q4	Same as Q1			
Q5	Same as Q1			
Q6	Same as Q1			

IF AMPLIFIER, 150 KC

IF-211-150

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
Q7	Same as Q1			
Q8	Same as Q1			
Q9	Same as Q1			
Q10	Same as Q1			
R1	Resistor, Fixed, Composition 150 ohm ±5% 1/4 W	AB	CB1515	2
R2	Resistor, Fixed, Composition 36 ohms ±5% 1/4 W	AB	CB3605	1
R3	Same as R1			
R4	Resistor, Fixed, Composition 10 K ohm ±5% 1/4 W	AB	CB1035	9
R5	Resistor, Fixed, Composition 100 ohm ±5% 1/4 W	AB	CB1015	8
R6	Resistor, Fixed, Composition 220 K ohms ±5% 1/4 W	AB	CB2245	2
R7	Same as R4			
R8	Resistor, Fixed, Composition 68 ohm ±5% 1/4 W	AB	CB6805	6
R9	Resistor, Fixed, Composition 2.2 K ohms ±5% 1/4W	AB	CB2225	2
R10	Same as R8			
R11	Same as R5			
R12	Same as R8			
R13	Same as R4			
R14	Resistor, Fixed, Composition 2 K ohm ±5% 1/4 W	AB	CB2025	2
R15	Same as R6			
R16	Same as R5			
R17	Same as R8			
R18	Same as R4			
R19	Same as R5			

IF AMPLIFIER, 150 KC

IF-211-150

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
R20	Resistor, Fixed, Composition 4.7 K ohms ±5% 1/4 W	AB	CB4725	2
R21	Same as R5			
R22	Same as R4			
R23	Same as R8			
R24	Resistor, Fixed, Composition 4.3 K ohms ±5% 1/4 W	AB	CB4325	1
R25	Same as R5			
R26	Same as R9			
R27	Same as R14			
R28	Same as R8			
R29	Same as R5			
R30	Resistor, Fixed, Composition 47 K ohms ±5% 1/4 W	AB	CB4735	2
R31	Same as R30			
R32	Same as R20			
R33	Resistor, Fixed, Composition 910 K ohms ±5% 1/4 W	AB	CB9145	1
R34	Same as R4			
R35	Same as R5			
R36	Same as R4			
R37	Resistor, Fixed, Composition 20 K ohm ±5% 1/4 W	AB	CB2035	1
R38	Same as R4			
R39	Same as R4			
R40	Resistor, Fixed, Composition 24 K ohms ±5% 1/4 W	AB	CB2435	1
Y1	Crystal Unit, Quartz, 18.9 mc	Piezo	CR64/U	1
Y2	Crystal Unit, Quartz, 2.5 mc	McCoy	M25	1

AGC AMPLIFIER, AGC-204

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C1	Capacitor, Fxd, Electrolytic (Tantalum) 22 uf ±20% 35 vdcw	Sprague	150D226X0035R2	4
C2	Same as C1			
C3	Capacitor, Fxd, Electrolytic (Tantalum) 2.2 uf ±20% 35 vdcw	Sprague	150D225X0035A2	2
C4	Capacitor, Fxd, Electrolytic (Tantalum) 0.1 uf ±20% 35 vdcw	Sprague	150D104X0035A2	2
C5	Capacitor, Fxd, Electrolytic (Tantalum) 1.0 uf ±20% 35 vdcw	Sprague	150D105X0035A2	2
C6	Same as C1			
C7	Same as C3			
C8	Same as C1			
C9	Same as C4			
C10	Same as C5			
CR1	Semiconductor Device, Diode	PSI/TRW	1N753A	2
CR2	Semiconductor Device, Diode	Sylvania	1N198A	2
CR3	Semiconductor Device, Diode	PSI/TRW	1N746A	1
CR4	Semiconductor Device, Diode	PSI/TRW	1N757A	2
CR5	Same as CR1			
CR6	Same as CR2			
CR7	Same as CR4			
Q1	Transistor	TI	2N697	11
Q2	Same as Q1			
Q3	Transistor	TI	2N335	2
Q4	Same as Q1			
Q5	Same as Q1			

AGC AMPLIFIER, AGC-204

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
Q6	Same as Q1			
Q7	Same as Q1			
Q8	Same as Q1			
Q9	Same as Q1			
Q10	Same as Q3			
Q11	Same as Q1			
Q12	Same as Q1			
Q13	Same as Q1			
Q14	Transistor	TI	2N1131	3
Q15	Same as Q14			
Q16	Same as Q14			
R1	Resistor, Fxd, Composition 330 K ohms ±5% 1/4W	AB	CB3345	2
R2	Resistor, Fxd, Composition 4.7 K ohms ±5% 1/4W	AB	CB4725	2
R3	Resistor, Fxd, Composition 10 K ohms ±5% 1/4W	AB	CB1035	4
R4	Resistor, Fxd, Composition 2.2 K ohms ±5% 1/4W	AB	CB2225	3
R5	Resistor, Fxd, Composition 5.6 K ohms ±5% 1/4W	AB	CB5625	2
R6	Resistor, Fxd, Composition 47 K ohms ±5% 1/4W	AB	CB4735	6
R7	Same as R6			
R8	Resistor, Fxd, Composition 100 K ohms ±5% 1/4W	AB	CB1045	4
R9	Resistor, Variable 50 K ohms ±5% 1/4W	Bourns	3068P-1-503	2
R10	Same as R6			
R11	Same as R8			
R12	Resistor, Fxd, Composition 8.2 K ohms ±5% 1/4W	AB	CB8225	2

AGC AMPLIFIER, AGC-204

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
R13	Same as R3			
R14	Resistor, Fxd, Composition 150 K ohms ±5% 1/4W	AB	CB1545	1
R15	Resistor, Fxd, Composition 2 K ohms ±5% 1/4W	AB	CB2025	2
R16	Resistor, Fxd, Composition 47 ohms ±5% 1/4W	AB	CB4705	4
R17	Same as R16			
R18	Same as R1			
R19	Same as R2			
R20	Same as R3			
R21	Same as R4			
R22	Same as R5			
R23	Same as R6			
R24	Same as R6			
R25	Same as R8			
R26	Same as R9			
R27	Same as R6			
R28	Same as R8			
R29	Same as R12			
R30	Same as R3			
R31	Resistor, Fxd, Composition 91 K ohms ±5% 1/4W	AB	CB9135	1
R32	Same as R16			
R33	Same as R3			
R34	Same as R4			
R35	Resistor, Fxd, Composition 2,4 K ohms ±5% 1/4W	AB	CB2425	1
R36	Same as R15			

AGC AMPLIFIER, AGC-204

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
R37	Same as R16			

VIDEO AMPLIFIER VA-202-1

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C1	Capacitor, Fixed, Ceramic Dielectric .01 uf ± 20% 50 VDCW	Sprague	19C214	1
C2	Capacitor, Fixed, Mica Dielectric 22 pf ± 5% 500 VDCW	Elmenco	DM10-220J	1
C3	Capacitor, Fixed, Tantalum 47 uf 35W VDC ± 20%	Sprague	150D476X0035S2	3
C4	Same as C3			
C5	Same as C3			
C6	Capacitor, Fixed, Tantalum 100 uf 20 W VDC ±20%	Sprague	150D107X0020S2	1
CR1	Semiconductor Device, Diode	PSI	IN753A	1
Q1	Transistor	TI	2N335	1
Q2	Transistor	TI	2N708	1
Q3	Transistor	TI	2N697	1
Q				
R1	Resistor, Fixed, Composition 30K ohms ±5% 1/4W	AB	CB3035	1
R2	Resistor, Fixed, Composition 4.7 K ohms ± 5% 1/4W	AB	CB4725	1
R3	Resistor, Fixed, Composition 270 K ohms ±5% 1/4 W	AB	CB2745	1
R4	Resistor, Fixed, Composition 2K ohms ± 5% 1/4 W	AB	CB2025	1
R5	Resistor, Fixed, Composition 1.8 K ohms ± 5% 1/4 W	AB	CB1825	1
R6	Resistor, Fixed, Composition 3K ohms ±5% 1/4 W	AB	CB3025	1
R7	Resistor, Fixed, Composition 390 ohms ±5% 1W	AB	GB3915	1
R8	Resistor, Fixed, Composition 20 ohms ±5% 1/4 W	AB	CB2005	1
R9	Resistor, Fixed, Composition 10 K ohms ± 5% 1/4 W	AB	CB1035	1

AUDIO AMPLIFIER AA-101

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C1	Capacitor, Tantalum Electrolytic 4.7 uf, +20%	Sprague	150D475X0035B2	1
C2	Capacitor, Tantalum Electrolytic 100 uf, ± 20%	Sprague	150D107X0020S2	1
C3	Capacitor, Tantalum Electrolytic 220 uf, ± 20%	Sprague	150D227X0010S2	2
C4	Same as C3			
C5	Capacitor, Ceramic Disc .01 uf, ± 20%, 50 v dc	Sprague	19C214	2
C6	Same as C5			
Q1	Transistor, Silicon	TI	2N697	4
Q2	Same as Q1			
Q3	Same as Q1			
Q4	Same as Q1			
R1	Resistor, Fixed Composition 2K ohms ± 5%, 1/4W	AB	CB 2025	1
R2	Resistor, Fixed Composition 68K ohms ± 5%, 1/4W	AB	CB 6835	2
R3	Resistor, Fixed Composition 12K ohms ± 5%, 1/4W	AB	CB 1235	2
R4	Resistor, Fixed Composition 100 ohms ± 5%, 1/4W	AB	CB 1015	2
R5	Resistor, Fixed Composition 510 ohms ± 5%, 1/4W	AB	CB 5115	1
R6	Same as R3			
R7	Same as R4			
R8	Same as R2			
R9	Resistor, Fixed Composition 8.2K ohm ± 5%, 1/4W	AB	CB 8225	2
R10	Resistor, Fixed Composition 510 ohms ±5%, 1/2W	AB	EB 5115	2

AUDIO AMPLIFIER AA-101

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
R11	Same as R10			
R12	Same as R9			
T1	Transformer, Driver	UTC	TF5RX13ZZ	1
T2	Transformer, Output	UTC	TF5RX17ZZ	1

POWER SUPPLY, PS-211

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C1	Capacitor, Fxd, Electrolytic (Tantalum) 100 uf ±20% 20 vdcw	Sprague	150D107X0020S2	2
C2	Capacitor, Fxd, Ceramic Dielectric 0.01 uf +80 -20% 50 vdc	Sprague	19C214	5
C3	Capacitor, Fxd, Electrolytic (Tantalum) 150 uf ±20% 15 vdcw	Sprague	150D157X0015S2	2
C4	Same as C2			
C5	Capacitor, Fxd, Electrolytic (Tantalum) 1.0 uf ±20% 35 vdcw	Sprague	150D105X0035A2	2
C6	Capacitor, Fxd, Electroltyic (Tantalum) 47 uf ±20% 35 vdcw	Sprague	150D476X0035S2	2
C7	Same as C2			
C8	Same as C6			
C9	Same as C1			
C10	Same as C2			
C11	Same as C3			
C12	Same as C2			
C13	Same as C5			
CR1	Semiconductor Device, Diode	PSI/TRW	1N754A	2
CR2	Semiconductor Device, Diode	PSI/TRW	1N717A	2
CR3	Same as CR2			
CR4	Same as CR1			
CR5	Rectifier, Semiconductor Device	Motorola	MDA-920-2	3
CR6	Same as CR5			
CR7	Same as CR5			
F1	Fuse, Cartridge 8 AG 1.0 Amp	Littelfuse	361001	3
F2	Same as F1			

POWER SUPPLY, PS-211

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
F3	Same as F1			
Q1	Transistor	TI	TI486	2
Q2	Transistor	TI	2N708	2
Q3	Transistor	TI	2N697	1
Q4	Same as Q1			
Q5	Same as Q2			
R1	Resistor, Fxd, Composition 1.3 K ohms ±5% 1/4W	AB	CB1325	4
R2	Same as R1			
R3	Resistor, Fxd, Composition 1.5 K ohms ±5% 1/4W	AB	CB1525	2
R4	Resistor, Fxd, Composition 1.8 K ohms ±5% 1/4W	AB	CB1825	4
R5	Resistor, Variable 1000 ohms ±20%	Bourns	3067P-1-102	2
R6	Resistor, Fxd, Composition 1.6 K ohms ±5% 1/4W	AB	CB1625	2
R7	Same as R4			
R8	Resistor, Fxd, Composition 510 ohms ±5% 1/4W	AB	CB5115	2
R9	Same as R8			
R10	Same as R1			
R11	Same as R1			
R12	Same as R3			
R13	Same as R4			
R14	Same as R5			
R15	Same as R6			
R16	Same as R4			

IA AMPLIFIER, IA-102

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C1	Capacitor, Fixed, Mica Dielectric 82 pf ±5% 500 VDCW	Elmenco	DM10-820J	1
C2	Capacitor, Fixed, Mica Dielectric 20 Pf ±5% 500 VDCW	Elmenco	DM10-200J	2
C3	Capacitor, Fixed, Ceramic Dielectric NPO ±60 ppm 6.8 pf ±.25 pf	Erie	301-COH-689C	1
C4	Same as C2			
C5	Capacitor, Fixed, Ceramic Dielectric 39 pf ±5% 500 VDCW	Elmenco	DM10-390J	1
C6	Capacitor, Fixed, Ceramic Dielectric .01 uf ±20% 50VDC	Sprague	19C214	3
C7	Capacitor, Fixed, Ceramic Dielectric .001 uf ±20% 1000 VDC	Sprague	40C214A	2
C8	Same as C7			
C9	Capacitor, Fixed, Composition 1.8 pf ±10% 500 VDCW	QC	MC-1.8	1
C10	Capacitor, Fixed, Ceramic Dielectric NPO ±60 ppm 4.7 pf ±.25 pf	Erie	301-COH-479C	1
C11	Same as C6			
C12	Capacitor, Fixed, Mica Dielectric 33 pf ±5% 500 VDCW	Elmenco	DM10-330J	1
C13	Same as C6			
C14	Capacitor, Fixed, Mica Dielectric 12 pf ±5% 500 VDCW	Elmenco	DM10-120J	1
C15	Capacitor, Fixed, Composition 1.0 pf ±10% 500 VDCW	QC	MC-1.0	1
C16	Capacitor, Fixed, Mica Dielectric 68 pf ±5% 500 VDCW	Elmenco	DM10-680J	4
C17	Same as C16			
C18	Same as C16			
C19	Same as C16			
C20	Capacitor, Fixed, Mica Dielectric 15 pf ±5% 500 VDCW	Elmenco	DM10-150J	1
C21	Capacitor, Fixed, Tantalum 2.2 uf 20W VDC	Sprague	150D225X0020A2	1
CR1	Semiconductor Device, Diode	Sylvania	1N198A	2
CR2	Same as CR1			

INPUT AMPLIFIER, IA-102

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
L1	Inductance, Standard, Fixed	ACL	AC-030-3	4
L2	Same as L1			
L3	Same as L1			
L4	Same as L1			
J1	Connector	FXR	5116-054900	1
Q1	Transistor	Motorola	2N3289	1
Q2	Transistor	ACL	A-395	3
Q3	Same as Q2			
Q4	Same as Q2			
R1	Resistor, Fixed, Composition 620 ohm ±5% 1/4W	AB	CB6215	1
R2	Resistor, Fixed, Composition 4.7 K ohm ±5% 1/4W	AB	CB4725	1
R3	Resistor, Fixed, Composition 1.0 K ohm ±5% 1/4W	AB	CB1025	1
R4	Resistor, Fixed, Composition 20 ohm ±5% 1/4W	AB	CB2005	1
R5	Resistor, Fixed, Composition 1.8 K ohm ±5% 1/4W	AB	CB1825	2
R6	Resistor, Variable 5 K ohm	CTC	CT150-5K	1
R7	Resistor, Fixed Composition 3.9 K ohm ±5% 1/4W	AB	CB3925	1
R8	Same as R5			
R9	Resistor, Fixed, Composition 10 ohm ±5% 1/4W	AB	CB1005	1
R10	Resistor, Fixed, Composition 200 K ohm ±5% 1/4W	AB	CB2045	2
R11	Same as R10			
R12	Resistor, Fixed, Composition 20 K ohm ±5% 1/4W	AB	CB2035	1
R13	Resistor, Fixed, Composition 1 M ohm 5% 1/4W	AB	CB1055	2
R14	Same as R13			

INPUT AMPLIFIER, IA-102

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
R15	Resistor, Fixed, Composition 100 K ohm ±5% 1/4W	AB	CB1045	1
R16	Resistor, Variable 1 M ohm	CTC	CT150-1M	1
Y1	Crystal Unit, Quartz Parallel resonant with 32 pf, case HC12/U	Piezo	21.400 mc	1
Y2	Crystal Unit, Quartz		To be determined	As Reqid

SDU IF & SWEEP CIRCUIT IFS 101

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C1	Capacitor, Ceramic Disc 1000 PF. ± 20%	Sprague	40C214A	5
C2	Capacitor, Ceramic Disc 0.01 uf ± 20%	Sprague	19C214	11
C3	Capacitor, Dipped Mica 51 pf ± 5%	Elmenco	DM10 - 510J	2
C4	Same as C2			
C5	Capacitor, Tubular Composition .47 pf ± 10%	Q.C.	MC 0.47	2
C6	Capacitor, Dipped Mica 39 pf ± 5%	Elmenco	DM10 - 390J	2
C7	Capacitor, Dipped Mica 390 pf ± 5%	Elmenco	DM10 - 391J	2
C8	Same as C2			
C9	Same as C1			
C10	Same as C3			
C11	Same as C2			
C12	Same as C5			
C13	Same as C6			
C14	Same as C2			
C15	Same as C7			
C16	Capacitor, Tubular Composition 3.9 pf ± 10%	Q.C.	MC 3.9	1
C17	Capacitor, Dipped Mica 30 pf ± 5%	Elmenco	DM10 - 300J	1
C18	Capacitor, Dipped Mica 160 pf ± 5%	Elmenco	DM10 - 161J	1
C19	Same as C2			
C20	Capacitor, Dipped Mica 300 pf	Elmenco	DM10 - 301J	1
C21	Same as C2			
C22	Capacitor, Dipped Mica 100 pf	Elmenco	DM10 - 101J	2
C23	Capacitor, Dipped Mica, 1500 pf	Elmenco	DM19 - 152J	1
C24	Capacitor, Tantalum, .1 uf	Sprague	150D104X0035A2	3

SDU IF & SWEEP CIRCUIT IFS 101

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C25	Same as C24			
C26	Same as C24			
C27	Same as C2			
C28	Capacitor, Dipped Mica 130 pf ± 5%	Elmenco	DM10 - 131J	1
C29	Same as C2			
C30	Capacitor, Tantalum .10 uf 100V DC ±20%	Sprague	150D104X0100A2	2
C31	Capacitor, Dipped Mica 10 pf ± 5%	Elmenco	DM10 - 100J	2
C32	Same as C31			
C33	Same as C30			
C34	Capacitor, Ceramic Tubular 6.8 pf ± 0.25 pf, NPOA ± 60 ppf	Erie	301-COH-689C	1
C35	Same as C1			
C36	Same as C2			
C37	Same as C1			
C38	Same as C1			
C39	Same as C22			
C40	Capacitor, Dipped Mica 2000 pf ± 5%	Elmenco	DM10 - 201J	1
C41	Same as C2			
C42	Capacitor, Ceramic 2.2 uf ± 20%	Sprague	5C15	6
C43	Same as C42			
C44	Same as C42			
C45	Same as C42			
C46	Capacitor, Tantalum Electrolytic 47 uf ± 20%	Sprague	150D476X0020R2	2
C47	Same as C46			
C48	Same as C42			

SDU IF & SWEEP CIRCUIT IFS 101

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
C49	Same as C42			
C50	Capacitor, Tantalum, Non Polarized 1.0 uf, 150 VDC	Sprague	112D105C3150D1	1
CR1	Diode, Germanium	Sylvania	1N198A	4
CR2	Same as CR1			
CR3	Diode	Sylvania	1N462A	4
CR4	Same as CR3			
CR5	Same as CR3			
CR6	Same as CR3			
CR7	Varactor	PSI	V15	1
CR8	Diode, Zener	PSI	1N717A	1
CR9	Same as CR1			
CR10	Same as CR1			
J1	Receptacle	CTC	3230-1	10
J2	Same as J1			
J3	Same as J1			
J4	Same as J1			
J5	Same as J1			
J6	Same as J1			
TP1	Same as J1			
TP2	Same as J1			
TP3	Same as J1			
TP4	Same as J1			

SDU IF & SWEEP CIRCUIT IFS 101

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
L1	Coil	ACL	AC-030-6	2
L2	Coil	ACL	AC-030-7	2
L3	Same as L1			
L4	Same as L2			
L5	Coil	ACL	AC-030-10	1
L6	Inductor, 1MH	Nytronics	WEE 1000	2
L7	Coil	ACL	AC-030-3	1
L8	Same as L6			
P1	Plug	CTC	3102-1-0312	2
P2	Same as P1			
Q1.	Transistor	Fairchild	SP 8675	6
Q2	Same as Q1			
Q3	Transistor	Motorola	2N3289	1
Q4	Same as Q1			
Q5	Same as Q1			
Q6	Same as Q1			
Q7	Transistor	TI	2N335	3
Q8	Same as Q1			
Q9	Transistor	TI	2N1131	1
Q10	Unijunction	TI	2N490	1

SDU IF & SWEEP CIRCUIT, IFS-101

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
Q11	Same as Q7			
Q12	Same as Q7			
Q13	Transistor	TI	SJ291A	2
Q14	Same as Q13			
R1	Resistor, Fixed Composition 10 K ohm ±5% 1/4W	AB	CB1035	5
R2	Same as R1			
R3	Resistor, Fixed Composition 1.8 K ohm ±5% 1/4W	AB	CB1825	3
R4	Resistor, Fixed Composition 1.0 K ohm ±5% 1/4W	AB	CB1025	8
R5	Resistor, Fixed Composition 4.7 K ohm ±5% 1/4W	AB	CB4725	3
R6	Same as R4			
R7	Resistor, Fixed Composition 20 Ohm ±5% 1/4W	AB	CB2005	1
R8	Same as R3			
R9	Resistor, Circuitrim 1 K ±10%	IRC	CT150-1K	1
R10	Resistor, Fixed Composition 3.9 K ohm ±5% 1/4W	AB	CB3925	1
R11	Same as R4			
R12	Same as R1			
R13	Resistor, Fixed Composition 6.2 K ohm ±5% 1/4W	AB	CB6225	1
R14	Resistor, Fixed Composition 2.2 K ohm ±5% 1/4W	AB	CB2225	2
R15	Resistor, Fixed Composition 56 K ohm ±5% 1/4W	AB	CB5635	2
R16	Same as R15			
R17	Same as R4			
R18	Resistor, Fixed Composition 5.6 K ohm ±5% 1/4W	AB	CB5625	1

SDU IF & SWEEP CIRCUIT IFS 101

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
R19	Same as R5			
R20	Resistor, Fixed Composition 5.1K ohms ± 5%, 1/4W	AB	CB 5125	3
R21	Same as R4			
R22	Resistor, Fixed Composition 1 M ohms ± 5%, 1/4W	AB	CB 1055	8
R23	Same as R22			
R24	Same as R22			
R25	Same as R22			
R26	Resistor, Fixed Composition 430 K ohms ± 5%, 1/4W	AB	CB 4345	1
R27	Resistor, Fixed Composition 3.0 K ohms ± 5%, 1/4W	AB	CB 3025	1
R28	Resistor, Fixed Composition 300 K ohms ± 5%, 1/4W	AB	CB 3045	1
R29	Same as R3			
R30	Resistor, Fixed Composition 91K ohms ± 5%, 1/4W	AB	CB 9135	1
R31	Same as R1			
R32	Same as R22			
R33	Same as R22			
R34	Resistor, Fixed Composition 100 K ohms ± 5%, 1/4W	AB	CB 1045	1
R35	Same as R20			
R36	Same as R5			
R37	Same as R4			
R38	Resistor, Fixed Composition 12 K ohms ± 5%, 1 W	AB	GB 1235	1
R39	Resistor, Fixed Composition 3.3K ohms ± 5%, 1/4W	AB	CB 3325	1
R40	Resistor, Variable 1 K ohm	CTC	150-102	1
R41	Same as R14			
R42	Resistor, Variable 50 K ohms	CTC	150-503	1

SDU IF & SWEEP CIRCUIT IFS 101

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
R43	Resistor, Fixed Composition 220 ohms ± 5%, 1/4W	AB	CB 2215	1
R44	Same as R1			
R45	Same as R20			
R46	Resistor, Variable 100 K ohms	CTC	150-104	1
R47	Same as R4			
R48	Same as R4			
R49	Resistor, Fixed Composition 11K ohms ± 5%, 1/4W	AB	CB 1135	2
R50	R esistor, Fixed Composition 470 K ohms ± 5%, 1/4W	AB	CB 4745	2
R51	Same as R50			
R52	Same as R49			
R53	Resistor, Fixed Composition 1.2K ohms ± 5%, 1/4W	AB	CB 1225	2
R54	Resistor, Fixed Composition 47K ohms ± 5%, 1/4W	AB	CB 4735	1
R55	Resistor, Fixed Composition 51 K ohms ± 5%, 1/4W	AB	CB 5135	1
R56	Same as R53			
R57	Same as R22			
R58	Same as R22			
R59	Resistor, Variable 1 M ohm	CTC	150-105	1
R60	Resistor, Fixed Composition 220K ohms ± 5%, 1/4W	AB	CB 2245	1
T1	Transformer	ACL	AC-030-18	1
W1	Cable Assy.	ACL	AC-076-32	1

SDU IF & SWEEP CIRCUIT IFS 101

SYM OR ITEM	NOMENCLATURE OR DESCRIPTION	MFR	PART NO.	QTY REQ
Y1	Crystal, 4.7550 MC parallel resonant with 32 pf, HC 18/U case	Pieze	HC 18/u 4.7550 mc	1
Y2	Crystal Bypass	Clevite	TF01A	1

2. Manufacturers List.

Abbreviation	Manufacturers
AB	Allen Bradley Company 136 W. Greenfield Avenue Milwaukee 4, Wisconsin
ACL	Astro Communication Laboratory 801 Gaither Road Gaithersburg, Maryland
Aemco	Telex/Aemco Div Telex Corp. 32 State Street Mankato, Minnesota
Aerovox	Aerovox Inc. New Bedford, Mass.
Allied Controls	Allied Controls Inc. 2 East End Ave. New York 21, New York
Amphenol	Amphenol-Borg Electronics Corporation 1830 S. 54th Avenue Chicago 50, Illinois
Belden	Belden Manufacturing Company 4015 S. Kilpatrick Ave. Chicago 44, Illinois
Bourns	Bourns, Inc., Trimpot Division 1200 Columbia Avenue Riverside, California
Cinch	Cinch Manufacturing Co. 1026 S. Horman Avenue Chicago, Illinois
Clevite	Clevite Electronic Components Co. 232 Forbes Road Bedford, Ohio
CTC (Cambion)	Cambridge Thermionic Corporation 445 Concord Avenue Cambridge, Massachusetts

Abbreviation	Manufacturers
Cut Hamm	Cutler Hammer, Inc. 411 N. 12th Street Milwaukee 1, Wisconsin
Dialco	Dialight Company 60 Stewart Avenue Brooklyn 37, New York
Elco	Elco Corporation Maryland Road & Computer Ave Willow Grove, Pennsylvania
Erie	Erie Technological Products, Inc. 644 W. 12th St. Erie, Pennsylvania
Fairchild	Fairchild Semiconductor Corporation 545 Whisman Road Mountain View, California
FXR/RF	FXR Div of Amphenol-Borg Electronics Corp Danbury, Connecticut
GE	General Electric Company Miniature Lamp Department Cleveland 12, Ohio
GI	General Instrument Co. 65 Gouverneur Street Newark 4, New Jersey
IRC	International Resistance Co. 401 N. Broad St. Philadelphia 8, Pa.
Littelfuse	Littelfuse, Inc. 800 E. Northwest Hwy Des Plaines, Illinois
Microdot	Microdot, Inc. 220 Pasadena Avenue South Pasadena, California

Abbreviation	Manufacturers
Motorola	Motorola Semiconductor Products, Inc. 5005 E. McDowell Road Phoenix, Arizona
McCoy	McCoy Electronic Co. Div. Oak Mfg Co. Mt. Holly Springs, Pa.
Nytronics	Nytronics, Inc. Essex Electronics Div. 550 Springfield Avenue Berkeley Heights, New Jersey
Oak	Oak Manufacturing Company Crystal Lake, Illinois
Piezo	Piezo Crystal Company 265 E. Pomfret Street Carlisle, Pennsylvania
PSI/TRW	TRW Electronics/Pacific Semiconductor 14520 Aviation Blvd Lawndale, California
QC	Quality Components, Inc. St. Marys, Pennsylvania
RCA	Radio Corporation of America Commercial Receiving Tube & Semiconductor Div. Somerville, N. J.
Reon	Reon Resistor Corp. 155 Saw Mill River Road Yonkers, New York
Roanwell	Roanwell Corporation 180 Varick Street New York 14, New York
Sealectro	Sealectro Corporation 139 Hoyte St. Mamaroneck, New York

Abbreviation	Manufacturers
Sprague	Sprague Electric Co. 125 Marshall Street North Adams, Massachusetts
Swcrft	Switchraft, Inc. 5537 N. Elston Avenue Chicago, Illinois
Sylvania	Sylvania Electric Products, Inc. 730 3rd Ave. New York, New York,
TI	Texas Instrument, Inc. Dallas, Texas
Triplett	Triplett Electrical Instrument Co. 286 Harmon Road Bluffton, Ohio
UTC	United Transformer Company 150 Varick Street New York, New York
Victoreen	Victoreen Instrument Co. 5806 Hough Ave. Cleveland 3, Ohio
Waterman	Waterman Electronic Tube Co. 1934 E. Hagert Street Philadelphia, Pennsylvania
Wilco	Wilco Corporation 4030 W. 10th St. Indianapolis, Indiana
Winchester	Winchester Electronics Co. Inc. 19 Willard Road Norwalk, Conn.